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THE EFFECTS OF FOREST MANAGEMENT PRACTICES ON NONGAME BIRDS: AN ANNOTATED BIBLIOGRAPHY

Marie T. Nietfeld
Edmund S. Telfer

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Canadian Wildlife Service

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I would like to extend my appreciation to those people who assisted in production of this document. Ed Telfer devised the project, and provided many of the references used in this bibliography. Terry Buxton (CWS library) assisted with interlibrary loans. Sam Barry set up the computer database file in Revelation and transferred the information out into a word processing file for editing and printing. Steve Cook spent much time assisting with information entry and file manipulations. Rick Paisley and Joanne Reynolds also helped with small sections of this project.

ABSTRACT

This annotated bibliography contains over 700 references which deal with: (1) effects, direct and indirect, of forest management practices on nongame forest birds, covering such topics as logging, cut types, rotation periods, thinning, site preparation, plantations, pesticides, herbicides, burning and regeneration; (2) forest bird-habitat relationships in both natural and sites disturbed by forestry operations or other practices which would produce similar situations; (3) factors affecting species diversity and biogeography distributions; (4) the role of birds in the forest ecosystem; and (5) management and conservation considerations for nongame forest birds, and some related techniques. The emphasis was placed on migratory songbirds in the boreal forest area. However, since few studies have investigated the effects of forestry practices on this category of birds in the boreal region, information was included for a variety of habitat types from all over North America, and a few from other regions. It was hoped that the findings and management considerations in these papers would provide useful information, and that some of the trends observed could be applied to the boreal region.

RÉSUMÉ

Cette bibliographie commentée contient plus de 700 références qui traitent: 1) des effets, directs et indirects, des pratiques d'aménagement forestier sur les oiseaux forestiers non recherchés par les sportifs, ce qui couvre des sujets comme l'exploitation forestière, les types de coupe, les périodes de rotation, les coupes d'éclaircie, le débroussaillement, les plantations, les pesticides, les herbicides, le brûlage et la régénération; 2) de la relation entre les oisseaux forestiers et leur habitat, que celui-ci soit naturel ou qu'il ait été perturbé par des opérations forestières ou d'autres pratiques entraînant des conséquences semblables; 3) des facteurs qui affectent la diversité des espèces et les distributions biogéographiques; 4) du rôle des oiseaux dans l'écosystème forestier; et 5) des questions de gestion et de conservation concernant les oiseaux forestiers non recherchés par les sportifs et certaines techniques s'y rapportant. Une importance particulière a été accordée aux oiseaux chanteurs migrateurs de la région de lat forêt boréale. Cependant, puisque peu d'études ont examiné les effets des pratiques forestières sur cette catégorie d'oiseaux dan la région boréale, des renseignements ont été inclus au sujet d'une variété de typesd'habitat répartis partout en Amérique du Nord et ailleurs. Ces documents ont été écrits avec l'espoir que les constatations et les questions d'ordre administratif qui y figurent fourniraient des renseignements utiles et que certaines des tendances observées pourraient étre appliquées à la région boréale.

INTRODUCTION

The bibliography contains references on the direct and indirect effects of forestry practices on nongame birds and their habitat. Topics covered include logging, cut type, rotation period, thinning, site preparation, herbicide and pesticide use, stand type, reforestation, regeneration, burns, etc., and how such conditions influence the avifauna of an area. The interactions between birds and their habitat is of great importance when assessing or predicting the effects of forestry operations. Thus, the relationships of avian diversity, density, distribution and abundance to forest type, structure, diversity, size, and succession stage are also considered in this document. Finally, articles with nongame bird management/conservation implications, recommendations, guidelines and techniques dealing directly or indirectly with forestry practices are included. Sources for this bibliography were: scientific journals, technical journals, publications from federal, provincial, and state agencies of Canada and the United States, and university theses.

This bibliography is meant to emphasize the effects of forest management on migratory songbirds of the boreal forest region or areas with similar vegetative characteristics. However, few studies have been conducted in the boreal forest, and thus the scope of the bibliography is expanded to include much of the information available from the United States. Although forest types and bird species differ for regions where the information was taken from, it was felt that the results, management implications, biological principles may be of interest, if not applicable, to those for the boreal area. I, therefore, leave the usefulness of the references to the discretion of the reader.

The bibliography is divided into four sections: (1) the Annotated references, (2) Subsection index, (3) Keyword index, and (4) and Author index. The Annotated References consist of (i) the reference number; (ii) the full reference of the article, book, or symposium by author(s), title, publisher or agency, and year(in a few cases of unpublished manuscripts, year and/or author are unknown); (iii) the abstract of the article (Most abstracts were taken directly from the article, though a few have deleted information not relevant to this bibliography. In the absence of an abstract, the summary (in whole or part) or other portions of the document were taken directly with only slight modification for ease of reading. These are designated by '*' preceding the abstract. If neither abstract or summary was available, and the article was too long to take exerts from, the content of the paper was briefly summarized, as indicated by '**'). References which were not available for review but were thought to contain material of interest were cited without keywords or abstract. The references are listed in alphabetically order, but due to the removal of a few paper, the reference numbers do not follow a complete chronological order.

The Subsection Index lists the author(s), year and reference number for each subsection category (see Table of Contents). The Keyword Index lists the keywords alphabetically, by subject and by location, with all corresponding reference numbers. The Author Index lists alphabetically the authors, year, and reference numbers.

ANNOTATED REFERENCES

1

Anonymous. n.d.
Model habitat management guidelines for deer, bear, hare, grouse, turkey, woodcock, and non-game wildlife.
Vermont Fish and Wildlife Department Agency of Environmental Conservation. 70 p.

KEYWORDS: habitat management guidelines;habitat/cover requirements;silvicultural systems;management techniques;nongame birds;mitigation;management objectives

ABSTRACT: The Vermont Department of Fish and Wildlife has prepared Model Habitat Management Guidelines for black bear, white-tailed deer, ruffed grouse, snowshoe hare, wild turkey, woodcock and non-game birds. The purpose of the guidelines is to assist land managers in reaching decisions on how to manage forest land in ways beneficial to key wildlife species. The non-game guidelines discusses general habitat and cover requirements, management goal and techniques, silvicultural systems, and management objectives.

2

Adams, D.;
Bird species diversity of natural and stressed mature forest ecosystems.
M.S. Thesis, Miami Univ., Oxford, Ohio 1974

KEYWORDS:

ABSTRACT: not reviewed

3

Adams, M.W.;
Effects of forest management practices on songbird populations.
Pp. 157-158. in: Rept. Forest Res. Forest. Comm., U.K. 1973

KEYWORDS:

ABSTRACT: not reviewed

4

Adams, M.W.; Edington,J.M.
A comparison of songbird populations in mature coniferous and broadleaved woods.
Forestry 46:191-202 1973

KEYWORDS: song-birds;population estimates;mature coniferous stands;mature deciduous stands;avian diversity

ABSTRACT: A comparison was made of song-bird populations in a series of 50-60 year-old coniferous and 90-100 year-old broadleaved woods in Tintern Forest and the Forest of Dean. Population estimates were obtained in ten breeding season by a mapping census method and in the winter by counts of birds in flocks. In both summer and in winter no appreciable difference was found in the total numbers of song-birds in the coniferous and broadleaved woods. The diversity of species, expressed as a diversity index, was, however, appreciably greater in the broadleaved sites.

5

Ahlen, I.;
Forestry and bird fauna in Sweden.
Ornis Fennica 52:39-44 1975.

KEYWORDS: modern forestry;bird fauna;population status;clear-cutting;afforestation;limiting factors;Sweden

ABSTRACT: The development of modern forestry in Sweden has resulted in changes in the quantitative composition of the bird fauna. The geographical distribution of a number of species has also been affected. To about 25 species forestry is thought to be unfavorable. Of these, 8 species have decreased markedly. About 20 species are probably favoured by forestry. Of these, about 6 species have increased markedly. Some species have both benefited and suffered. The paper deals mainly with the following questions: (1) the fate of the woodpeckers Dendrocopos medius, D. leucotos and Picus canus; (2) large trees as a limiting factor in the nesting of some large birds of prey; (3) importance of fruit-bearing trees for C. coccotbraustes and Nucifraga caryocatactes; (4) the effect of clear-cutting of the natural and virgin forests of the taiga in northern Sweden; (5) the effect of afforestation of former open land; (6) the fauna of clear-cut areas.

6

Ahlen, I.;
Forestry and the vertebrate fauna
Ecol. Bull. 21:59-62 1976

KEYWORDS: forestry-wildlife interactions;clearcutting;afforestation;avian diversity;bird-habitat relationships;management implications

ABSTRACT: The effects of forestry on the vertebrate fauna in Sweden are discussed with regard to types of forestry-wildlife interactions and selection of scientific approaches to the problem. Examples of known or probable effects on some mammals, birds, reptiles and amphibians are given. A limited number of mammal and bird species have increased mainly because of increased clear-cut areas. A larger number of birds, a few mammals, two species of reptiles and at least two species of amphibians are unfavourably affected or endangered by forestry mainly as a result of destruction of specific habitats.

7

Ahlgren, I.F.; Ahlgren, C.E.
Ecological effects of forest fires.
Bot. Rev. 26:483-533 1960

KEYWORDS: forest fire;ecological effects;soil fertility;plant composition;animals: effects on

ABSTRACT: **The effects of forest fire on soil, plants and animals are reviewed in this article. Examples of the effects of fire on birds are given.

8

Airola, D.A.;
Foraging and habitat relations of insectivorous birds in a managed Sierra Nevada mixed conifer forest.
M.S. Thesis, Univ. Calif., Berkeley. 59 p. 1979

KEYWORDS:

ABSTRACT: not reviewed

9

Airola, D.A.; Barrett, R.H.
Foraging and habitat relationships of insect-gleaning birds in a Sierra Nevada mixed-conifer forest.
Condor 87:205-216 1985

KEYWORDS: insect-gleaning birds;habitat ordination;foraging patterns;resident birds;migrant birds;coniferous forest;deciduous forest;management implications;Sierra Nevada USA

ABSTRACT: Foraging habits and relative abundance of 12 birds comprising the insect-gleaning guild in a Sierran mixed-conifer forest were studied during two breeding seasons to determine: (1) foraging habitat preference, (2) the extent to which species differ in their use of various components of the foraging niche, (3) patterns of relative abundance vs. niche breadth, and (4) differences between resident and migrant species. Comparisons of proportional availability and bird use of foliage height were used selectively by the guild. Resident and migrant species groups showed few fundamental differences in foraging patterns, except that migrants tended to use a greater proportion of deciduous foliage than residents. Results suggest that to provide for this guild, land managers should maintain natural levels of tree species diversity in the mixed-conifer forest type.

10

Alatalo, R.V.;
Multidimensional foraging niche organization of foliage-gleaning birds in northern Finland.
Ornis Scand. 13:56-71 1982

KEYWORDS: foliage-gleaning birds;foraging ordination;interspecific competition;migratory status;bird-habitat relationships;Finland

ABSTRACT: Six foraging niche dimensions (habitat, tree species, tree size, height in tree, tree part, feeding posture) were studied and multidimensional niche overlaps and breadths, which take into account the most important dependencies between niche axes, were calculated. The most important axes, tree species and tree part, explained 77% of six-dimensional foraging niche differences in summer and up to 87% in winter. Summer visitors, at least partly, used resources rejected by residents (deciduous trees, low trees).

11

Allen, A.W.;
Habitat suitability index models: barred owl.
USDA Int., Fish and Wildl. Serv., Nat. Ecol. Center. Biol. Rept. 82-10.143. 16 p. 1987

KEYWORDS: habitat suitability;barred owl;habitat requirements;habitat evaluation;management implications

ABSTRACT: A review and synthesis of existing information were used to develop a Habitat Suitability Index (HSI) model for the barred owl. The model consolidates habitat use information into a framework appropriate for field application, and is scaled to produce an index between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). HSI models are designed to be used with Habitat Evaluation Procedures previously developed by U.S. Fish and Wildlife Service.

12

Ambrose, R.E.;
The effect of small-tract clearcutting on populations of birds and small mammals.
Ph.D. Dissertation, University of Tennessee. 287 p. 1975

KEYWORDS: avian ecology;avian diversity;avian density;breeding bird populations;clearcutting;selective cutting;post-logging responses;habitat selection;edge effects;hardwood forest;Tennessee USA

ABSTRACT: Absolute censuses of breeding birds and small mammals were made on four study areas in Anderson County, Tennessee over a three-year period with an additional breeding bird survey made on a fifth area for one season. The cutting process used on two of the areas was small-tract (less than 20.2 ha) hardwood clearcutting without removal of the felled non-merchantable timber and allowing natural regeneration. The clearcuts were studied in their early growth stages, up to the three-year-old age class. Two other areas were used as control plots and held mature hardwood timber. The fifth study area was a selectively-cut forest with a small clearing in the center. Data were obtained on 51 species of birds that either had territories within or visit the study areas. Overall breeding bird populations for two years were 3.0 and 3.6 times higher in a clearcut interior than in an adjacent forest, which was shown to be statistically highly significant. Seven months after the cutting of one of the forest areas at the midpoint of the study, it was found that ten species decreased in abundance, while sixteen species increased and five species remained unchanged in number. In the selectively-cut woodland there was a clumping of bird territories in the vicinity of the 0.3 ha clearing, with 92% of the territories on the 10.5 ha plot occurring within 30.5 m of the center of the clearing. The effect of the edge between the forest and the clearcut was found to be greater on the distribution of birds than of mammals in the study. Seven out of twenty-three species of birds were found to have a high preference for the edge, while the effect was negligible for most mammals.

13

Ambuel, B.; Temple, S.A.
Area-dependent changes in the bird communities and vegetation of southern Wisconsin forests.
Ecology 64:1057-1068 1983

KEYWORDS: avian ecology;passerines;competition;deciduous forest;migratory status;management implications;habitat selection;forest fragmentation;island biogeography;Wisconsin USA

ABSTRACT: We studied avian biogeography and habitat selection in forests of southern Wisconsin ranging from 3 to >500 ha. Bird diversity in these woodlots increases with area, due primarily to an increase in the number of forest-dwelling, long-distance migrants. We consider two possible explanations for this pattern: (1) area-dependent changes in forest vegetation, or (2) area-dependent change in interactions with competitors, predators, or brood parasites. We first describe vegetation structure and composition, then show that this description comprises important habitat features of forest birds. Bird habitat is characterized in three ways: (1) vegetational structure within bird territories is compared with that at random locations in the same woodlots, (2) structural characteristics of territories of different species are compared, and (3) factors related to species' abundance in different woodlots are analyzed. We found no area-dependent trends in vegetation structure or composition that seem likely to influence the bird community. However, forest-edge and farmland species increase in density as woodlot area decreases. We suggest that forest-edge and farmland species exclude certain forest-dwelling, long-distance migrants from small woodlots, and that this exclusion influences the bird community more than area-dependent changes in habitat or the degree of woodlot isolation.

14

Anderson, B.W.; Ohmart, R.D.;Rice, J.
Avian and vegetation community structure and then seasonal relationships in the lower Colorado River Valley.
Condor 85:392-405 1983

KEYWORDS: bird-habitat relationships;avian diversity;avian density;migratory status;forest structure;principal component analysis;Colorado USA

ABSTRACT: Records of vegetation density and seasonal bird species richness, densities, and diversities for 78 line transects along the lower Colorado River were examined to: 1) isolate seasonal and spatial patterns of avian community variation; 2) determine relationships between patterns of attributes in avian communities and vegetation characteristics; and 3) evaluate effects of different spatial levels of investigation. Principal components analysis of foliage density and diversity measures revealed two important, independent patterns of variation among transects. Avian density was usually independent of, and more regularly arranged than, diversity within each season. Regression of principal components, derived from principal components analysis of avian community attributes on vegetation components, showed that avian density was more closely related to variation in the vegetation than was avian diversity. Avian community attributes outside the breeding season were more highly correlated with the vegetation measures than were those for communities during the breeding season. Vegetation density and diversity were both important predictors of avian community measures at the habitat level but accounted for little of the variation in bird communities at the transect level. Additional principal components analyses using the combined avian and vegetation data evaluated at the habitat level produced results similar to those found at the transect level. When we analyzed vegetation and avian community variables together, results were similar to previous findings. The additional studies reinforced the findings of the first analyses, although when evaluating habitat data, avian and vegetation variables were more closely associated than when the analysis was conducted using a more local spatial scale. Several generalizations were possible. For example, common summer visitors in mature cottonwood-willow habitats differed ecologically from species visiting structurally simpler cottonwood-willow habitats in summer. The general similarities among habitats when considering resident avian species contrasted with the differences when species present only part of the year were considered.

15

Anderson, R.J.;
Bald eagles and forest management.
For. Chron. 61:189-193 1985

KEYWORDS: bald eagles;wildlife management;nesting habitat;forest management

ABSTRACT: Current management of known bald eagle nesting habitat on Weyerhaeuser Company lands in Oregon and Washington states is described. Observations of continued nesting productivity indicate that with careful planning successful integration of forest and eagle habitat management is achievable. Forest management programs can provide nesting habitat concurrent with the production of forest products by manipulation of forest stand structure using site-specific management plans. Factors to be considered in maintaining suitable nesting habitat relate to the specific location and prominence of the area relative to the surroundings and tree crown conditions within areas of potential eagle use. Management for nesting habitat must be directed towards the entire potential nesting site, rather than at individual nest trees for maintenance of successful eagle nesting.

16

Anderson, S.H.;
Changes in forest bird species composition caused by transmission-line corridor cuts.
American Birds 33:3-6 1979

KEYWORDS: habitat disturbance;avian diversity;migratory status;transmission-line corridor cuts;edge effect;deciduous forest;Tennessee USA

ABSTRACT: *A before and after study conducted for five years in a deciduous forest community in eastern Tennessee showed that all bird species lost from the habitat as a result of cutting a transmission-line corridor were migrants whereas only 36% of the replacement species were migratory. Although two of the species observed in the area following the cut were nomadic, most were attracted by features such as singing posts and grassland habitat. Bird species diversity decreased significantly in each of the four years following the cut.

17

Anderson, S.H.;
Habitat structure, succession and bird communities.
Pp. 9-21 in: R.M. DeGraaf and K.E. Evans, tech. coord. Management of north central and northeastern forests for nongame birds. Workshop Proc., Jan 23-25, 1979, Minneapolis, Minnesota. USDA For. Serv. Gen. Tech. Rept. NC-51. 1979

KEYWORDS: avian ecology;avian succession;avian diversity;forest succession;bird-habitat relationships;habitat selection;timber management;fire;logging;edge-effect;management implications

ABSTRACT: Birds select habitats by several different mechanisms to supply the requisite needs of the species. Several statistical tests can be used to correlate bird species with habitat variables. Combining variables by means of factors analysis can indicate how species relate to forms of disturbance in forest habitats. Natural changes in forest community structure that occur in plant succession can be altered by many human caused disturbances. These disturbances, which include fire, logging, increasing edge, retention of snags and maintaining a diverse habitat, are also effective tools for the manager of nongame birds.

18

Anderson, S.H.;
Habitat selection, succession, and bird community organization.
Pp. 13-26 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: habitat selection;avian communities;bird-habitat relationships;stepwise multiple regression;discriminant function analysis;principal component analysis;factor analysis;management implications

ABSTRACT: Nongame bird community management is suggested based on habitat, plant succession, and bird community organization. Suggested forms of stratification of habitat are examined. Factors that indicate habitat selection and bird community organization are shown by means of discriminant function analysis, principal component analysis, and factor analysis. Factors such as habitat size, habitat structure, water impoundment, and edge are related to nongame bird communities.

19

Anderson, S.H.;
Correlating habitat variables and birds.
Proceedings of Symposium on estimating the numbers of terrestrial birds. Studies in Avian Biology 6. 1981

KEYWORDS: avian ecology;bird-habitat relationships;habitat correlations;habitat variables;multivariate statistics;management implications

ABSTRACT: A brief overview of habitat correlation with birds by the use of multivariate statistics is presented. Examples taken from studies conducted in different forest habitats show that many species are correlated with macro features of the community such as habitat size and distance to the edge of the woods. Few data are available to distinguish clearly habitat where species are present or absent. Analytic tests must be carefully selected. It is important that the assumptions of the tests are met. Care must be taken to determine that habitat variables found in one part of the range of the species are applicable to other parts. It is necessary to select habitat variables that discriminate between places where a species is found and is not found. To accomplish this goal, it is necessary to sample habitat or a species' territory. Finally, the results of correlation tests must be verified with field tests to assure their reliability.

20

Anderson, S.H.; Mann, K.;Shugart, H.H., Jr.
The effect of transmission-lines corridors on bird populations.
Am. Midl. Nat. 97:216-221 1977

KEYWORDS: transmission-line corridors;edge effects;corridor width;avian diversity;avian density;deciduous forest;Tennessee USA

ABSTRACT: Observations of bird populations were made along transmission-line corridors of four different widths in areas in which the transmission-line right-of-ways traversed typical eastern Tennessee deciduous forest. In addition, detailed grid-mapping of individual birds was conducted in forest and in 30.5 m-wide corridor habitat. Narrow corridors (12 m) had reduced bird species diversity, but the 30.5 m corridor had high bird density and diversity. The wider corridors were less diverse but attracted several open-country bird species not characteristic of the surrounding forest. Significance of the effects of the 30.5 m corridor on the distribution of 35 bird species was determined. The highest species diversity was associated with the forest habitat.

21

Anderson, S.H.; Robbins, C.S.
Habitat size and bird community management.
Trans. N. Am. Wildl. and Nat. Res. Conf. 46:511-519 1981

KEYWORDS: forest fragmentation;biogeography;migratory birds;management implications

ABSTRACT: The purpose of this paper is to review the results in the literature that show the effect of area of forest on nesting migratory bird species, and to present the results of additional field work that we have conducted in forest habitats in western Maryland. These results indicate that area sensitivity of many long distance migrants. Because 80 to 95 percent of the breeding birds in the northeastern deciduous forest are neotropical migrants (MacArthur 1959), the changes in bird species composition as a result of forest fragmentation can be immense. Management strategies based on habitat size are suggested to assist in maintaining communities of nesting migratory birds.

22

Anderson, S.H.; Shugart, H.H.
Habitat selection of breeding birds in an east Tennessee deciduous forest.
Ecology 55:828-37 1974

KEYWORDS: avian ecology;breeding birds;habitat selection;bird-habitat relationships;competition;multivariate analysis;Tennessee USA

ABSTRACT: Bird populations were sampled between May 30 and July 20, 1972, on twenty-four 0.08 ha plots on Walker Branch Watershed, a primarily deciduous forest located in Anderson County, Tennessee. Univariate analysis of variance was used to test for differences in abundance categories of each bird species with respect to 28 habitat variables. Differences were apparent from this analysis. Discriminant function analysis was therefore used to order the variables according to their strength in separating abundance categories for 13 of the more abundant bird species. This analysis indicated that some bird species were distributed according to specific habitat variables. For example, Downy Woodpecker abundance was highly correlated with the number of saplings on a plot. Distributions of other species (e.g., the Scarlet Tanger) were not strongly related to any single variable but were related weakly to a large number of variables. The results form a basis for predicting avifaunal composition changes resulting from alteration of habitat structure.

23

Anderson, S.H.; Shugart, H.H. Jr.;Smith, T.M.
Vertical and temporal habitat utilization within a breeding bird community.
Pp. 203-216 in: J.E. Dickson, R.N. Conner, R.R. Fleet, J.C. Krill, and J.A. Jackson, eds. The role of insectivorous birds in forest ecosystems. Academic Press, New York. 381 pp. 1979

KEYWORDS: avian communities;breeding birds;avian diversity;habitat utilization;resource partitioning;vertical stratification;temporal stratification;Tennessee USA

ABSTRACT: Vertical and temporal stratification of birds in an eastern deciduous forest are discussed. It is shown that habitat use varies among species within the vertical strata and on a temporal basis in the forest. Subdivision of the habitat by means of behavioral differences in time and in the vertical is shown as an additional means of resource partitioning. Bark gleaning birds show a vertical stratification while canopy feeders are active at different times. Vertical and temporal stratification and stratification of behavior are shown to be forms of community subdivisions which allow birds to use the forest habitat.

24

Apfelbaum, S.; Haney, A.
Bird populations before and after wildfire in a Great Lakes pine forest.
Condor 83:347-354 1981

KEYWORDS: avian ecology;avian diversity;avian density/biomass;foraging guilds;importance values;fire: wild;post-fire responses;pine-spruce forest;Minnesota USA

ABSTRACT: Birds in a 6.25 ha quadrat in a 73 year old jack pine-black spruce forest in Cook Co., Minnesota were intensively studied in June 1976. A wildfire burned through the area in August. The following spring we resurveyed the same quadrat to determine the first-year changes in bird populations. Species and guilds were compared by density, territorial space, existence energy, and importance values. Twelve species had territories in the study grid before the fire; six were not there the following spring, but eight additional species had established territories. Tree-foliage searchers had the greatest importance value before the fire and ground-brush foragers the greatest value afterwards. Density, total biomass, and combined existence energy of birds decreased after the fire by 50, 23, and 41%, respectively, but species using the area after the fire were 63% heavier on the average. Average energy consumption per unit of body weight was calculated to be 23% less after the fire. Fire apparently reduced the total food available for birds, but increased the kinds of food, especially at or near the ground.

25

Arbuckle, J.;
Snags: widowmakers or wildlife habitat?
Pp. 149-157 in: J.A. Bissonette, ed. Is good forestry good wildlife management? Proc. of a Joint Conference, March 6-8, 1985, Portland, Maine. 1986

KEYWORDS: snags;snag management;forest management;conflict;economics;hazard;snag formation;techniques

ABSTRACT: Both wildlife managers and foresters generally agree that snags provide important wildlife habitat for a wide variety of species. Many studies have supported this finding. Yet planned retention of snags is not a part of most large or small scale logging operations. Conflicts exist between the needs of woodland managers and wildlife, particularly as intensive forest management practices become more widespread. Solutions to these problems are discussed.

26

Askins, R.A.; Philbrick, M.J.
Effect of changes in regional forest abundance on the decline and recovery of a forest bird community.
Wilson Bull. 99:7-21 1987

KEYWORDS: forest fragmentation;afforestation;migratory birds;competition;Connecticut USA

ABSTRACT: Bird populations were monitored for 32 years in a 23-ha tract of hemlock hardwood forest. Between 1953 and 1976 the total abundance of long-distance migrants declined significantly and four species disappeared, but after 1976 both the total abundance and the number of species increased. Multiple regression analysis shows that the abundance of long-distance migrants was negatively related to abundance of bird species characteristics of suburban habitats and positively related to the amount of forest within 2 km of the study area. The decline in long-distance migrants before 1976 occurred when suburban species were increasing and nearby forest was destroyed. The increase after 1976 is best explained by reforestation in the surrounding area because suburban birds were still increasing. A diversity of forest species, including many long-distance migrants, became established in the reforested areas. This pattern suggests that immigration from nearby forests is important in maintaining the abundance of long-distance migrants.

27

Askins, R.A.; Philbrick, M.J.;Sugeno, D.S.
Relationship between the regional abundance of forest and the composition of forest bird communities.
Biol. Conserv. 39:129-152 1987

KEYWORDS: forest fragmentation;species diversity;forest-interior birds;management implications;Connecticut USA

ABSTRACT: We surveyed bird populations in 46 forest tracts in Connecticut, USA, to determine how the distribution of birds is related to forest area, isolation from other forests, and vegetation structure. Both the density and species richness of forest-interior birds tend to be lower in smaller forests. Some species show a significant tendency to be absent from small forests, while others are present in small forests but have higher densities in large forests. This pattern is apparently not related to vegetation structure. Sites that are more isolated from other forests also tend to have fewer forest-interior birds. Forest area is the best predictor of the density and species richness of forest-interior birds for small forests, while isolation is the best predictor for large forests. Our results indicate that maintenance of a diversity of forest-interior birds will require preservation of large areas of forest.

28

Austin, D.D.; Perry, M.L.
Birds in six communities within a lodgepole pine forest.

J. Forestry 77:584-586 1979

KEYWORDS: avian communities;avian diversity;avian density;clearcutting;management implications;pine: lodgepole;Utah USA

ABSTRACT: Birds were censused in six communities within a lodgepole pine forest in the Uinta Mountains of Utah: wet and dry meadows, mature and stagnated lodgepole pine stands, and openings made by clearcutting in 1940 and 1960 and presently having regenerating lodgepole pine stands. The richest avifauna was in the dry meadows, a finding that suggests the need to protect these areas from disturbance. Although a few bird species were adversely affected by clearcutting, many were more numerous in the clearcut areas than in unlogged stands, and the number of species remained about the same. Disturbance of the stagnated stands would be highly beneficial to birds.

29

Back, G.N.;
Avian communities and management guidelines of the aspen-birch forest.
Pp. 67-79 in: R.M. DeGraaf, Tech. Coord. Proc. workshop on management of northcentral and northeastern forests for nongame birds. USDA For. Serv., Gen. Tech. Rep. NC-51. 1979

KEYWORDS: avian communities;avian succession;avian density;forest succession;timber management;management implications;North America

ABSTRACT: Avian communities are discussed in relation to succession of the aspen-birch type. Management guidelines are given, but more information on habitats of stenotopic species is required if comprehensive management plans are to be formulated. Avian management and pulpwood management are generally compatible in the aspen-birch type, but some expenditures may be necessary to maximize bird species diversity.

30

Back, G.N.;
Impacts of management for ruffed grouse and pulpwood on nongame birds.
Ph. D. Thesis, Univ. Minnesota, Minneapolis, 96 pp. 1982

KEYWORDS: pulpwood management;clearcuts;regeneration;rotation period;avian diversity;avian density;bird-habitat relationships;nest sites;foraging sites;post-logging response;Minnesota USA

ABSTRACT: Response of nongame birds to management for ruffed grouse and pulpwood was evaluated. Two bird species-habitat associations were based on presence and density of species in habitats of different ages. Changes in availability of foraging substrates and nest sites in regeneration following clearcutting were important factors determining species presence. Species richness and mean density were lower on mature forest areas than on commercial clearcuts. The current management program resulted in an increase of species richness, total avian density, and habitat diversity. However, a 40-year rotation would have a negative impact on cavity-nesting species, bark-foraging species, and raptors. Options for several levels of management for grouse, pulpwood, and nongame birds are provided. Removal of forest canopy by clearcutting was expected to reduce bird species diversity (BSD). However, BSD values on clearcuts 2- to 5-years old were greater than BSD of mature forests. This unexpected result prompted an evaluation of the relationship between foliage height diversity (FHD) and BSD. The FHD-BSD relationship was found to have limited predictive capability. The FHD index does not include information about presence of various life forms, distribution of foliage within each layer, or non-foliage avian resources. Other factors that can influence BSD independently of FHD also are not incorporated in the relationship. Application of the Shannon index to biological systems that include species of various trophic levels, territory sizes, and biomasses presents difficulties in interpretation. Standards need to be developed to make comparisons of BSD values meaningful.

31

Balda, R.P.;
Foliage use by birds of the oak-juniper woodland and ponderosa pine forest in southeastern Arizona.

Condor 71:399-412 1969

KEYWORDS: foliage structure;avian communities;avian utilization;habitat selection;avian distribution;Arizona USA

ABSTRACT: *The object of this study is to depict the height distribution and volume of foliage in two different plant communities and to show how the total avifaunal utilizes this dimension of their habitat during the breeding season. When possible, foliage use by individual bird species is discussed to show their contribution to the overall pattern of use. Data on utilization are expressed in terms of volume of foliage rather than area.

32

Balda, R.P.;
The relationship of secondary cavity nesters to snag densities in western coniferous forests.
USDA For. Serv. Wildl. Habitat Tech. Bull. 1. 37 p. 1975

KEYWORDS:

ABSTRACT: not reviewed

33

Balda, R.P.;
Vegetation structure and breeding bird diversity.
Pp. 59-80 in: D.R. Smith, tech. coord. Proc. of the symposium on management of forest and range habitats for nongame birds. USDA For. Serv. Gen. Tech. Rept. WO-1. 1975

KEYWORDS: avian ecology;avian diversity;vegetation structure;bird-habitat relationships;breeding birds;forest succession avian succession;avian succession;management implications

ABSTRACT: Breeding bird communities consist of individual species that select a definable area because of the presence of requirements needed for reproduction. The actual process of habitat selection is complex. The avian community is a result of eons of evolution by both the plants which supply requisites and the birds which must be efficient harvesters of these requisites. Numerous structural components of the community have been found to be of value in predicting bird species diversity. Foliage height diversity appears to be the best factor measured to date but percent cover, foliage volume, plant species diversity, and foliage height are also useful measures from which to predict bird species diversity. The presence or absence of seeds, fruits, and berries are possibly important, but to date have not been fully assessed. Ecotones created by the interdigetation of successional stages are known to support greater diversity than homogenous communities, and late successional stages support greater species diversity than earlier stages because of vegetative complexity. Most studies to date on breeding birds and their vegetative substrate have been correlational and have not measured the components of the plant community used by the breeding birds. Because of this the manager has little idea of what a particular vegetative component of the community provides the breeding birds. Most seral and ecotonal species may have relatively great dispersal potential, wide ranges of tolerance, and high reproductive rates. Birds restricted to climax communities may have relatively low dispersal powers, narrow ranges of tolerance and low reproductive rates. If such is the case, then climax communities may require more attention than presently given them as areas to maintain a select group of bird species with narrow ecological ranges of tolerance.

34

Balda, R.P.; Gaud, W.S.;Brawn, J.D.
Predictive models for snag nesting birds.
Pp. 216-222 in: J.W. Davis, G.A. Goodwin, R.A. Ockenfels, eds. Snag habitat management proceedings of the symposium. USDA For. Serv. Gen. Tech. Rept. RM-99. 1983

KEYWORDS: cavity nesting birds;snag density;bird-snag relationships;predictive model;regression analysis;management implications

ABSTRACT: Multiple regression models were developed and their predictive power tested for the five common secondary cavity nesting birds in the ponderosa pine forests. Variables included in the regression analysis included seven vegetation ones and 11 climatic ones. All models were highly significant and explained between 50 and 89 percent of the variation in breeding bird density. Snag density, which appeared as an important variable in four of five models, had a positive affect on breeding bird density. Snags are the most important variable determining density of most of the secondary cavity nesters.

35

Balen, J.H. van; Booy, C.J.H.;Francker, J.A. van;Osieck, E.R.
Studies of hole-nesting birds in natural nest sites 1. Availability and occupation of natural nest sites.
Ardea 70:1-24 1982.

KEYWORDS: natural nest sites;cavity tree characteristics;nest site selection;cavity-nesting birds;Netherlands

ABSTRACT: *The scarcity of studies on hole-nesting birds in natural nest sites prompted us to undertake such a study, and to compare the results with those obtained with nest-boxes. The study was performed in 1975-1977 in a wooded area north of Arnhem, where many roads are bordered with old deciduous trees, rich in tree holes. The study area consisted of three sets of roads and a 9 ha plot of deciduous woodland. From the suitable holes found several measures were taken. Suitable holes occurred in densities of 6-30 per ha, or 3-11 per 100 trees. High densities were found along the roads presumably because the surrounding forest was rather young and unsuitable for hole excavation. Conifers had very few holes, but the various deciduous tree species did not differ in hole density. Young trees (trunk circumference smaller than 60 cm) had no holes at all and there was a general tendency for hole density to increase with the age of the trees. All measured hole parameters showed considerable variability, enabling a wide selection of species to nest. Many species were found but Starling and Great Tit predominated. Occupation percentages were high (54-93%), especially in 1975 and 1977. The species composition differed appreciably from that in neighbouring nest-box areas. These differences can be understood from the differences in size and entrance diameter between nest-boxes ant tree holes. The annual fluctuations in the numbers of clutches of the most common species corresponded with the fluctuations found in several nest-box areas. The properties of occupied and unoccupied holes were compared for all species together and for the most common species separately, in order to study preferences and inter-specific competition. In general, holes with a large diameter, depth, bottom area, and volume were occupied most frequently, as well as holes exposed to eastern directions.

36

Bamford, R.;
Nestboxes in forestry plantations.
Q.J. For. 79: 153-158. 1985

KEYWORDS: cavity-nesting birds;breeding birds;avian density;avian diversity;nest-boxes;plantations;deciduous forest;Wales

ABSTRACT: The introduction of nestboxes within plantations of Japanese larch, and beech, resulted in an increase in hole-nesting bird species with little or no effect on other resident songbirds. Nestboxes were also commonly used by Long-eared bats, and dormouse, the latter predating several boxes used by Pied flycatchers.

37

Bamford, R.;
Broadleaved edges within conifer forest. The importance to bird life.
Q. J. For. 80: 115-121. 1986

KEYWORDS: forest diversity;edge;avian diversity;avian density;bird-habitat relationships;habitat suitability;forest management;Wales

ABSTRACT: Broadleaved trees and shrubs around restock conifer plantation perimeters are important bases for many songbird territories. Although not all species make use of these fringe habitats, sufficient do so to make retention and, where possible, improvement of these fringes an important forest management consideration.

38

Barney, C.W.; Dils, R.E.
Bibliography of clearcutting in western forests.
College of Forestry and Natural Resources, Colorado State Univ., Fort Collins. 65 p. 1972

KEYWORDS: clearcutting;forest practices;forest environment;western forest;bibliography

ABSTRACT: **A bibliography containing references on various aspects of clearcutting in the forest ecosystem.

39

Bart, J.;
Effects of acephate and servin on forest birds.
J. Wildl. Manage. 43:544-549 1979

KEYWORDS: forest management;insecticides;Acephate;Sevin;avian ecology;post-spraying response;management implications

ABSTRACT: *The effects of Acephate and Sevin were studied on forested plots in New York. Plots were surveyed using the singing-male mapping technique prior to and following treatments. Following the Acephate application, a decline occurred in the number of red-eyed vireos, as well as in rose-breasted grosbeaks and scarlet tangers, the only other canopy gleaners present. The post treatment decline in vireo song was concentrated in the interior of the treated plot rather than being spread throughout. No other differences were observed. Sevin produced no detectable effects on the 8 normally treated, forested plots or on the heavily treated, scrub-growth plot. Only 2 of the 8 normally treated plots had lower totals than their controls. A total of 332 individuals were recorded on the treated plots; 282 individuals were recorded on the untreated plots. On the heavily treated scrub-growth plot, the most common species declined slightly on the treated plot, though singing was not affected. House wrens continued to initiate nesting attempts in areas heavily treated with Sevin, and successfully brought off their young.

40

Batten, L.A.; Pomeroy, D.E.
Effects of re-afforestation on the birds of Rhum, Scotland.
Bird Study 16:13-16 1969

KEYWORDS: afforestation;pine plantations;forest succession;avian diversity;avian density;avian succession;conservation implications;Scotland

ABSTRACT: *The total density of birds following afforestation doubled during the first year. In eight-year old plantations, the density was seven times greater than newly planted moorland and three woodland species were present. Densities in the 60 year old plot were somewhat greater than those of the eight-year old plantation. Avian diversity was lowest on the unplanted moorland and continued to increase to the 60 year old plantation.

41

Beals, E.W.;
Forest bird communities in the Apostle Islands of Wisconsin.
Wilson Bull. 72:156-181 1960.

KEYWORDS: bird populations;forest succession;habitat ordination;habitat preference;Wisconsin USA

ABSTRACT: *The bird populations of 24 stands of forest vegetation on the Apostle Islands of Lake Superior were censused by a sample count method. A two-dimensional ordination of the stands was constructed, based on the avifaunal similarities between stands. The ordination represents an environmental complex, within which many bird species are distributed in definite patterns. Certain vegetational characteristics of the stands also show well-developed patterns within the ordination, indicating that they may play an important role in the environmental complex. The species of birds observed are discussed in relation to their apparent environmental preferences. The possible influences of island size and of the behavior of birds in relation to island topography are discussed.

42

Beaver, D.L.;
Avian species diversity and habitat use in forests of the Sierra Nevada. California.
Ph.D. Diss., Berkeley, Univ. California. 1972

KEYWORDS:

ABSTRACT: not reviewed

43

Beaver, D.L.;
Avian populations in herbicide treated brush fields.
Auk 93:543-553 1976

KEYWORDS: bird populations;brush fields;herbicide treatment;California USA

ABSTRACT: Avian population size and species composition did not change with herbicide treatment of the habitat because the essential elements of the habitat in the proximate sense only were not altered for each species. The changes in species abundance and composition were the result of factors operating on the entire brush field avifauna.

44

Beebe, S.B.;
Relationships between insectivorous hole-nesting birds and forest management.
Yale Univ. School of For. and Envir. Studies. New Haven, CT. 49 p. 1974

KEYWORDS: review;insectivorous birds;cavity-nesting;biological insect control;forest management;forest economics;snag management

ABSTRACT: The ecology of the hole-nesting habit is reviewed and the generalization made that in most cases the most important limiting factor on the populations of hole-nesting birds is the scarcity of suitable hole, and in some cases roost-sites or suitable hole-nest building sub-strata. Some old, dead or dying and partially decayed trees are seen as an essential habitat component. The safety of the hole-nest has resulted in a relatively high breeding potential in hole-nesters, and a high degree of competition for scarce nest-sites. Excavating woodpeckers play an important role in providing nest-holes for secondary hole-nesters. Artificial nest boxes have been used successfully to increase populations of hole-nesting insectivorous birds in commercial forests. Insect damage in American forest is a significant cause of annual growth-loss. As a component of natural biotic control insectivorous hole-nesting birds, in many cases, play an important role in the regulation of forest insect populations. Food capacity of individual avian predators is high, and both functional and numerical responses to changes in insect prey density have been demonstrated. Through simplification of the forest ecosystem forestry practices decrease the suitability of the forest as habitat for hole-nesting birds, while increasing the susceptibility of the forest to insect outbreaks. The protection of hole-nesting bird populations by promoting diversity, leaving snags and other means is advocated as an economical means to help prevent insect outbreaks in the managed forest.

45

Beedy, E.C.;
Bird communities and forest structure in the Sierra Nevada of California.
Condor 83:97-105 1981

KEYWORDS: bird populations;forest structure;bird-habitat relationships;mixed conifer;avian diversity;Sierra Nevada California USA

ABSTRACT: I examined the relationship of forest structure and vegetation diversity to bird communities in the mixed conifer and red fir zones of the central Sierra Nevada. Bird populations were censused in open- and closed-canopy forests in both vegetation zones to test the prediction that structurally similar forests support similar avifaunas. Comparisons of bird and vegetation data revealed that forest canopy cover was a primary factor influencing the size and composition of avian communities in the nesting and post-nesting seasons. Closed-canopy forests had lower bird densities, diversities, species richness and consuming biomasses than open-canopy forests in both vegetation zones. The composition of feeding guilds was similar in the two canopy types, but ground-understory foragers, hummingbirds and flycatchers were less abundant in the closed forests. The open forests had well-developed understories and higher foliage-height diversities offering a greater array of foraging substrates for birds.

46

Bekken, J.;
Effect of modern forestry on bird species diversity in Norway: a summary of present knowledge based on a literature review.
Rapport, Norsk Institutt for Skogforskning 7: 1988

KEYWORDS:

ABSTRACT: not reviewed

47

Bell, M.A.M.; Brown, J.M.;Hubbard, W.F.
Impact of harvesting on forest environments and resources.
Forestry Technical Report 3. Canadian Forestry Service, Dept. of Environ., Ottawa. 237 pp. 1974

KEYWORDS: bibliography;timber harvest: effects of;forest environments;forest resources

ABSTRACT: **A bibliography containing over 1500 references related to the impacts of timber harvest on forest environments.

48

Bendell, J.F.;
Effects of fire on birds and animals.
Pp. 73-138. In: T.T. Kozlowski and C.E. Ahlgren, eds., Fire and ecosystems. Academic Press, New York. 1974

KEYWORDS: fire;logging/burns;post-fire response;avian ecology;species diversity;species density;foraging behaviour

ABSTRACT: **A chapter which deals with the effect of fire on the life and environment of birds and mammals, and considers how species have evolved to live in a fire frequented environment. Topics covered include 1) the immediate reactions to fire; 2) long-term effects of fire: a) local climate and microclimate, b) structure of vegetation, c) pattern of cover within a burn; 3) food; 4) species changes after fire; 5) change in density and trend after fire and 6) adaptations at the population level. Results from a review of research studies are used as available information. For birds, most breeding species stayed after a forest fire, a few species disappeared and a few new species moved in. The greatest loss was from foragers of the tree trunks and tree canopy, and the greatest gain was among those that fed on or near the ground. Most bird species remained at a steady density both on burned and unburned areas.

49
Bergstedt, B.; Niemi, G.J.
A comparison of two breeding bird censuses following the Little Sioux forest fire.
The Loon 28-33 1974

KEYWORDS: fire;post-fire responses;avian diversity;avian density;breeding birds;vegetation changes

ABSTRACT: *Two breeding bird population studies were conducted in the 1971 Little Sioux burn of the BWCA. Comparative results of the two study plots indicates no drastic change in population levels two years after the fire. Based on the research conducted in unburned communities previously cited, however, it is plausible to assume the population is not as high as it would be if the fire had never occurred. The species content of both plots was drastically changed from what would be expected in a normal aspen or jack pine stand. Once again these changes would be expected and attributed to the fires destruction of the predominant vegetation. The species changes would be considered temporary and indicative of the bird composition in a brush or seedling stage of plant succession.

50
Best, L.B.; Stauffer, D.F.;Geier, A.R.
Evaluating the effects of habitat alteration on birds and small mammals occupying riparian communities.
Pp. 117-124 in: Proceedings of the symposium on strategies for protection and management of floodplain wetlands and other riparian ecosystems. USDA For. Serv. Gen. Tech. Rept. WO-12. 1979

KEYWORDS: habitat alteration;bird populations;riparian communities;habitat selection;tolerance indices;techniques;Iowa USA

ABSTRACT: Birds and small mammals were censused along stream segments in Iowa, representing a range of habitats from open fields to closed-canopy woodlands. Vegetation was sampled and general habitat types identified. The reciprocal of Simpson's index was used to express breadth of habitats selected and nest-site specificity. The general application of using an index of niche breadth in conjunction with conventional plant and animal sampling techniques to assess species' susceptibility to habitat alteration is discussed.

51
Bibby, C.J.;
Management in commercial conifers for birds.
Pp. 60-65. in: Jardine, D.C., ed. Wildlife management in forests. Proceedings of a discussion meeting, Univ. Lanscater, 3-4 April 1987, Edinburgh, UK. Instit. of Chartered Foresters. 1988

KEYWORDS:

ABSTRACT: not reviewed

52
Bilcke, G.;
Residence and non-residence in passerines: dependence on the vegetation structure.
Arden 72:223-227 1984

KEYWORDS: passerines;migratory status;vegetation structure;bird-habitat relationships;biogeography;Europe

ABSTRACT: *Counts of passerine birds in nine different habitats have shown that the proportions of resident, mediterranean migrant, and tropical migrant individuals were significantly correlated with the vegetation structure, showing that migrants are more abundant in open vegetation, while residents prefer the woodlands. Likewise, considering all Belgian passerine species, migration distance decreases from open habitat to forest. In contrast, literature data show that in New World the migrants and residents are about equally abundant in open habitats and forest. Since the two existing hypotheses can only explain the European but not the American situation, I propose the alternative hypothesis that the proportion of migrants in their breeding areas is determined by the occurrence and geographical distribution of different vegetation types in their winter quarters.

53

Bilcke, G.;
Breeding songbird community structure: influences of plot size and vegetation structure.
Acta Oecol. 3:511-521 1982

KEYWORDS:

ABSTRACT: not reviewed

54

Bilcke, G.;
Bird species turnover along a heathland to pine forest succession.
Pp. 67-69 in: F.J. Purroy, ed., Bird Census and Mediterranean Landscape. Proceedings of the VII Infern. Bird Census Conference, 1981, Leon, Spain. 1981

KEYWORDS:

ABSTRACT: not reviewed

55

Bissonette, J.A., ed.;
Is good forestry good wildlife management?
Proceedings of a Joint Conference, March 6,7,8, 1985. Maine Agric. Exp. Stn., Miscel. Publ. No. 689. 377 p. 1986

KEYWORDS: forestry management;wildlife management

ABSTRACT: **A symposium which examines various facets of forest management and their effects on wildlife and wildlife management.

56

Black, H. Jr.; Thomas, J.W.
Forest and range wildlife habitat management ecological principles and management systems.
Pp. 47-55 in: R.M. DeGraaf, tech. coord. Proceedings of the workshop on nongame bird habitat management in the coniferous forests of the western United States. USDA For. Serv. Gen. Tech. Rept. PNW-64. 1978

KEYWORDS: ecosystem principles;plant communities;plant succession;timber/range management;wildlife management principles

ABSTRACT: Basic principles that govern ecosystems, components of plant communities, their attendant successional stages and their relationships to habitat are discussed. Timber and range management practices can modify plant communities in forest and range land ecosystems. Basic wildlife management principles and management systems that guide and modify timber and range management activities are shown. Well coordinated management can simultaneously achieve several predictable resource goals.

57

Blackford, J.L.;
Woodpecker concentrations in burned forests.
Condor 57:28-30 1955

KEYWORDS: woodpeckers;coniferous forest;fire;Montana USA

ABSTRACT: **Describes the number of woodpeckers observed on 60 acres of recent burn in a coniferous forest, Montana.

58

Blake, J.G.;
Influence of fire and logging on nonbreeding bird communities of ponderosa pine forests.
J. Wildl. Manage. 46:404-415 1982

KEYWORDS: avian communities;habitat alteration;fire;logging;partial cut;clear-cut;post-fire response;post-logging response;species diversity;Arizona USA

ABSTRACT: Nonbreeding bird communities were censused on burned and unburned study plots in ponderosa pine habitat of Prescott National Forest, Arizona. Logging had occurred on 2 burned and 2 unburned plots. Forty-nine species of birds were recorded during fall, winter, and spring. Twenty-eight species were recorded on burned, and 38 species on unburned plots. During all seasons, more species were restricted to unburned study plots; more species on unburned sites occurred on only 1 site. Species composition on different areas was related to foraging substrate availability and to season. Habitat alterations caused by fire and by logging appeared to have a similar influence on many components of avian communites. Patterns during nonbreeding seasons paralleled, in many instances, response of breeding season communities to similar habitat change.

59

Blake, J.G.;
Ecological relationships of bird communities in forest islands of east-central Illinois.
Ph.D. Diss., Univ. Illinois, Urbana-champaign, Illinois. 1983

KEYWORDS: avian ecology;avian diversity;bird-habitat relationships;forest fragmentation;forest size;foraging behaviour;migratory status;management implications;conservation implications;Illinois USA

ABSTRACT: East-central Illinois is devoted primarily to agriculture and remaining tracts of forest serve as valuable habitat islands for a variety of species. Preservation of many species is dependent on large blocks of forest. Bird communities in forest tracts (15 total, 1.8 to 600 ha) were studied during 1979, 1980, and 1981 to investigate ecological relationships of these communities. During summer, total species richness of a forest and species richness at a given point within a forest were strongly correlated with forest area. Total species richness increased with area at a more rapid rate, indicating the importance of spatial segregation of species in larger forests. Much of the segregation was related to variation in habitat structure within a forest. However, habitat exerted a much weaker influence on community structure than did area. The relationship between area and species richness varied with migratory strategy and preferred breeding habitat. Neotropical migrants and species dependent on forest interior habitat were poorly represented in small forests. Many are dependent on extensive blocks of forest and continued reduction and fragmentation of forests may adversely affect such species. Small forests were dominated by omnivores; larger forests had greater numbers of foliage and bark insectivores. Species richness in major trophic groups was correlated with area. Bird communities of small forests also supported a morphologically diverse set of species. Analyses based on euclidean distances indicated that species packing increased from small to larger forests (few to many species). Results differed significantly from random, indicating that species interactions likely influence community structure. Analyses of winter communities indicated a strong correlation between species richness and area. Trophic structure varied with area although granivores were most abundant over all areas. Large forests provide food and protection from adverse weather and may be critical to overwinter survival of many species. Results from this study indicate that large forests are necessary for many species. Small forests of equal total size will not support the same species complement as a single large forest. Strategies for species preservation must be based on analysis of species composition, not simply on total species richness.

60

Blake, J.G.;
Trophic structure of bird communities in forest patches in east-central Illinois.
Wilson Bulletin 95:416-430 1983

KEYWORDS: avian ecology;avian communities;bird diversity;trophic structure;migratory birds;habitat size;forest fragmentation;Illinois USA

ABSTRACT: *Trophic structure of breeding bird communities in isolated forests (1.8-600 ha.)in east-central Illinois was studied 1979-1981. Breeding species were assigned to one of seven trophic groups; two groups (nectarivore-frugivore, granivore) were represented by few species or individuals. Abundance and species richness within the remaining five groups varied with forest area and appeared tied to the size and structure of the forest itself and to the composition of the surrounding landscape. Small forests were dominated by omnivores that frequently foraged in surrounding farmland. Foliage insectivores, primarily Neotropical migrants, were uncommon in smaller forests, but comprised the largest component of bird communities in large forests. Species totals in major trophic groups were significantly correlated with area in all years. Highest correlations were observed for foliage insectivores and bark insectivores. The former group had the highest slope, indicating the most rapid increase in species number with area, a reflection of the increase in number of long-distance migrants in larger forests. Correlation with area generally was not as high for abundance of individuals within trophic groups. However, abundances of both foliage and bark insectivores were strongly correlated with area. Over the size range of forests covered, distribution of species within major trophic groups differed from that expected if species occurrences were independent of forest area. Omnivores were more common than expected in large forests. Foliage insectivores were underrepresented over the entire range of forest size. Thus, trophic groups were not represented in all forests simply according to their contribution to the total species pool, suggesting that abundance of different food resources varied in dissimilar ways with forest area.

61

Blake, J.G.; Karr, J.R.
Species composition of bird communities and the conservation benefit of large versus small forests.
Biol. Conserv. 30:173-187 1984

KEYWORDS: avian ecology;avian communities;avian diversity;forest-interior birds;migratory birds;resident birds;habitat size;forest fragmentation;wildlife reserves;Illinois USA

ABSTRACT: Preservation of many species depends on the existence of parks and wildlife reserves that form islands of natural habitat. Isolated patches of forest provide habitat islands for many bird species in the heavily farmed region of east-central Illinois. Here we use data collected from 12 forest patches, ranging in size from 1.8 to 600 ha, to examine the benefit of two small reserves relative to a single large reserve. Observed and predicted species overlap values are used to determine whether one or two forest patches are more likely to support a greater number of species. Two reserves were more likely to support a greater species total. However, long-distance migrants and forest-interior species were poorly represented in small forests and a single large reserve was more likely to support greater species totals for these groups. The reverse was true for short-distance migrants and permanent residents.

62

Blake, J.G.; Karr, J.R.
Breeding birds of isolated woodlots: area and habitat relationships.
Ecology 68:1724-1734 1987

KEYWORDS: avian ecology;avian communities;breeding birds;bird diversity;migratory birds;habitat size;habitat structure;forest fragmentation;Illinois USA

ABSTRACT: We investigated breeding bird communities of isolated woodlots (1.8-600 ha) in east-central Illinois during three summers (1979-1981) to compare the influence of area and habitat on community structure. Woodlots supported from 9 to 43 species and composition was relatively constant among years. Ecological generalists dominated small woodlots, while more specialized species increased in importance with area. Area accounted for most variation (86-98%) in total species number in each year and the species-area relationship did not change significantly among years. The amount of variance accounted for by area was greater than in previous studies. Neither habitat nor woodlot insolation explained significant additional variation in total species richness after area. Area accounted for most variation in number of species in different migratory and breeding habitat categories, except for short-distance migrants, which correlated most strongly with habitat. Variation in habitat was not related to woodlot area and habitat accounted for additional variation in bird species numbers in most cases. Abundances of one-third to one-half of species examined correlated with woodlot area, but a greater proportion (66-72%) were influenced more strongly by habitat variables. Results from Illinois support previous conclusions that species that breed in forest interior habitat and winter in the tropics are most likely to be adversely affected by a reduction in forest habitat. Results also show that bird communities in isolated tracts of forest are not random assemblages, but rather that species found in smaller woodlots are subsets of species found in larger forests.

63

Blondel, J.; Ferry, C.;Frochot, B.
Avifaune et vegetation essai d'analyse de la diversite.
Alaude 41:63-84 1973

KEYWORDS:

ABSTRACT: not reviewed

64

Blood, D.A.; Anweiler, G.G.
Forest nesting habitat of ancient murrelet in the Queen Charlotte Islands. Pp. 297-302 in: W.R. Meehan, T.R. Merell, Jr. and T.A. Hanley, eds. Proceedings of a symposium of fish and wildlife relationships in old-growth forest. American Inst. of Fish. Res. Biol., Northw. Sect., The Wildlife Society. 1984

KEYWORDS: ancient murrelets;nesting habitat;forest structure;conifer forest;management implications;Queen Charlotte Islands

ABSTRACT: Nesting habitat of ancient murrelets in the Queen Charlotte Islands is described. Fourteen major nesting colonies were estimated to occupy about 600 ha of forest land in the late 1970's. Most of that area is coniferous forest over 140 years in age and dominated by western hemlock, Sitka spruce, and western red cedar. Ancient murrelets in this area used nesting sites with the following characteristics: over-mature forest, open understory dominated by bryophytes; moderate to steep slope toward the ocean; and within 325 m horizontal distance of the shoreline. Four colonies comprising less than 20% of the Queen Charlotte breeding population are protected in Ecological Reserves. We believe that forest harvesting could adversely affect the nesting habitat of ancient murrelets.

65

Bock, C.E.; Bock, J.H.
Responses of birds and deer mice to prescribed burning in ponderosa pine.
J. Wildl. Manage. 47:836-840 1983

KEYWORDS: habitat disturbance;fire: prescribed;post-fire response;avian population;nesting;South Dakota USA

ABSTRACT: *Managers of pine forests in the Black Hills are interested in using prescribed fire to restore original pine grassland ecotones, to reduce fire hazard, and perhaps to improve wildlife habitat. We studied the short-term effects of 2 cool-season prescribed burns on vegetation, breeding birds, and deer mouse in pine forests and savannahs in the Black Hills of South Dakota. The prescribed burns reduced fuels, slowed pine invasion and recruitment, and temporarily improved habitat for 1 rodent and 7 songbird species. In addition to deer mice, the American robin, mountain bluebird, solitary vireo, yellow-rumped warbler, western tanger, dark-eyed junco, and chipping sparrow were positively affected by the burns in the 1st post-fire year. Overall effects of the 2 cool-season burns on vegetation were modest. There was a reduction in litter and young pine, but in general the forests and savannahs appeared little changed. In contrast, the fires resulted in dramatic increases of deer mice and nesting birds during the 1st post-fire summer, an effect that disappeared or even reversed itself by the 2nd year.

66

Bock, C.E.; Lynch, J.F.
Breeding bird populations of burned and unburned conifer forest in the Sierra Nevada.
Condor 72:182-189 1970

KEYWORDS: avian ecology;bird populations;bird diversity;bird biomass;breeding birds;habitat disturbance;fire;forest succession;post-fire responses;coniferous forest;California USA

ABSTRACT: *The breeding avifaunas of burned and unburned coniferous forest in the Sierra Nevada were censused over a three-year period using two permanent grids. Of 32 regularly breeding species 28 per cent were unique to the burned plot, while 19 per cent occurred only in the unburned forest. In addition to post-fire vegetation, the burned plot contained small pockets of mature conifers spared by the fire. Perhaps as a result of this heterogeneity, the breeding avifauna of the burned area was slightly richer (26 species vs. 23) and more diverse than in the unburned forest. The types of birds present closely paralleled the nature of the vegetation in the two areas. Species adapted to forage among the needles of living conifers were much more common on the unburned plot while species characteristic of low brush and open ground predominated on the burn. Although the number of birds breeding on each plot was nearly the same, the biomass was much greater on the burned study plot. The burn supported birds which were heavier on the average, and which, because of larger body size, presumably utilized available energy more efficiently. Salt (1957) has suggested that communities approaching "climax" conditions are characterized by larger and more efficient avifaunas. However, forest fires are considered to reverse rather than advance succession. It seems likely that the burn supported heavier birds than the mature forest simply because of the different problems of foraging in the two areas. The aggregate energy flow was probably quite comparable in the forest and in the burn.

67

Bock, C.E.; Raphael, M.;Bock, J.M.
Changing avian community structure during early post-fire succession in the Sierra Nevada.
Wilson Bull. 90:119-123 1978

KEYWORDS: fire;forest succession;post-fire response;bird-habitat relationship;avian communities;avian diversity;coniferous forest;California USA

ABSTRACT: **Changes in avian community structure were recorded during early post-fire succession stages in the Sierra Nevada. Species richness, species diversity, and evenness all were highest on the burned plot in 1968, lowest on the burn in 1975, and intermediate on the unburned plot in both years. Although some of these differences are minor, diversity on the burned plot was considerably higher in 1968 than in 1975. There was a much greater change over 7 years on the burned plot compared to the unburned forest. This is a reflection of relatively rapid and dramatic successional events in the post-fire community. Less expectedly, the breeding bird populations of the burned and unburned forest were more similar in 1968 than they were in 1975. That is avian communities lost rather than gained similarity over the 7-year period.

68

Boecklen, W.J.;
Effects of habitat heterogeneity on the species-area relationships of forest birds.
J. Biogeog. 13:59-68 1986

KEYWORDS: avian ecology;avian diversity;habitat size;habitat heterogeneity;bird-habitat relationships;principal component analysis;conservation implications

ABSTRACT: Habitat heterogeneity is an important underlying component of the species-area relationship. I directly measure its effects on the species-area relationships of forest birds with data from the 45th Breeding Bird Census. A habitat space for thirty-four plots is created by principal components analysis. Euclidean distance within this space is used as a measure of between-plot habitat differences. By combining pairs of plots to create a series of composite plots, I convert measures of between-plot differences in vegetation structure into measures of within-plot habitat heterogeneity. I calculate all 561 pairwise distances within the habitat space. I combine species counts and areas for 104 pairs of plots selected from the lower tail, middle, and upper tail of the pairwise-distance distribution. Habitat heterogeneity is a significant predictor of species number even after area is factored out. Furthermore, the set of pairs selected from the three regions of the pairwise-distance distribution differ significantly in the intercepts or in the slopes of their species-area regressions. Implications for conservation are discussed.

69

Bond, R.R.;
Ecological distribution of breeding birds in the upland forests of southern Wisconsin.
Ecol. Monogr. 27:351-384 1957

KEYWORDS: avian distribution;avian diversity;bird-habitat relationships;forest structure;foraging behaviour;hardwood forest;Wisconsin USA

ABSTRACT: *The populations of breeding birds were analyzed in 64 upland hardwood stands, distributed along a vegetational and moisture gradient from xeric oak woods to mesic sugar maple. Several bird species showed little or no quantitative response to the vegetational differences, though others exhibited preference for stand type and moisture conditions. Analysis of the responses of bird species to size of forest showed 4 species were more common in small woods, 10 species were more common in larger woods and some species were not influenced. Differences in foraging niches and nest site selection was also evident in to stand type. Population diversity and density were greatest in the intermediate stands along the gradient. Similarity indices showed that a continuum of bird communities existed between those of open, xeric deciduous forest stands and those of more dense, mesic stands.

70

Bowman, G.B.; Harris, L.D.
Effect of spatial heterogeneity on ground-nest depredation.
J. Wildl. Manage. 44:806-813 1980

KEYWORDS: habitat heterogeneity;spatial heterogeneity;ground-nesting birds;nest depredation;Florida USA

ABSTRACT: Field enclosures were used to test effects of spatial heterogeneity on raccoon (Procyon lotor) depredation of dummy nests. Three levels of spatial heterogeneity were created by varying the density, species composition, and interspersion of nesting cover. Trials consisted of releasing a raccoon into an enclosure in which 5 clutches of bobwhite quail (Colinus virginianus) eggs had been placed randomly. High levels of spatial heterogeneity increased ($p<0.01$) search time and reduced the number of clutches found. Foraging efficiency (the number of clutches found per unit time) decreased greatly as spatial heterogeneity increased. Handling and consumption time did not differ ($P>0.05$) among levels of heterogeneity. All raccoons reduced their search time with experience, irrespective of heterogeneity level. Depredation did not differ ($P>0.05$) between partially and totally concealed nests. Spatial heterogeneity appears to be more important than nest concealment in reducing nest depredation.

71

Brawn, J.D.;
The relationship of cavity nesting birds to snags in the oak-hickory forest.
M.S. Thesis (Unpubl), Univ. of Missouri, Columbia. 105 pp. 1979

KEYWORDS:

ABSTRACT: not reviewed

72

Brawn, J.D.; Elder, W.H.;Evans, K.E.
Winter foraging by cavity nesting birds in an oak-hickory forest.
Wildl.Soc.Bull. 10:271-275 1982

KEYWORDS: cavity-nesting birds;foraging patterns;snags characteristics;habitat suitability;management implications;oak-hickory forest;Missouri USA

ABSTRACT: "In regard to the present study of birds wintering in the oak-hickory forest, we recommend that snags in the largest available size classes with rough bark should be retained during thinning or sanitation cuts. Snags that are just beginning to decay should be retained because they are the preferred winter foraging substrates and eventually will be suitable for woodpecker excavation of nest and roost holes and subsequently furnish secondary (i.e. non-excavating) cavity nesters with holes. Maintenance of cavity nesting bird habitat will help to maintain the natural composition of forest bird communities, enhance the biological control of insect pests, and provide for the public's enjoyment of wildlife.

73

Brawn, J.D.; Tannenbaum, B.;Evans, K.E.
Nest site characteristics of cavity nesting birds in central Missouri.
USDA For. Serv. Res. Note. NC-314. 1984

KEYWORDS: snags;forest structure;bird-habitat relationships;cavity-tree characteristics;breeding birds;cavity-nesting birds;management implications;deciduous forest;Missouri USA

ABSTRACT: Two studies sites in central Missouri oak-hickory forests were searched for nest sites of cavity-nesting birds. Researchers located and measured 133 nests of 11 species. Cavity-nesting bird habitat selection is affected by both snag characteristics and vegetation structure.

74

Brittingham, M.C.; Temple, S.A.
Have cowbirds caused forest songbirds to decline?
Bioscience 33:31-35 1983

KEYWORDS: avian ecology;forest fragmentation;endangered species;forest songbirds;bird populations;brood parasitism;reproductive success;population declines;deciduous forest

ABSTRACT: Brown-headed cowbird populations and their rate of brood parasitism on forest songbirds in eastern North America have increased since 1900. Brood parasitism of forest songbirds is highest near open habitat. High brood parasitism rates within isolated fragments of forest habitat reduce reproductive success of certain forest songbirds and may be responsible for their recent declines.

75

Bromley, R.G.;
Fire and birds: a bibliography
Univ. Alaska, Fairbanks 7 pp. 1973

KEYWORDS: bibliography;fire;birds;post-fire response

ABSTRACT: **The subject of this bibliography is the effects of fire on birds and on their habitat as evidenced by ecological responses of birds. The bibliography contains 91 references, and spans a period of 1923-1972.

76

Bruns, H.;
The economic importance of birds in the forest.
Bird Study 7:193-208 1960

KEYWORDS: avian ecology;forest birds;population density;bird-insect relationships;foraging patterns;nest-boxes;economic importance

ABSTRACT: The economic importance of birds in forests has been studied in many countries, but perhaps most intensively in Germany. This paper reviews our knowledge of the subject. Much information now exists on the composition of the insect food taken by forest species of birds and the amount they can eat in a stated period. But, although it has been shown that they devour large numbers of pest species, there is less information about what proportion of an insect population is removed by birds. There is evidence to suggest that this proportion does not increase when a plague develops. Methods of increasing the density of birds are discussed, particularly the provision of nest-boxes. It has been shown that, by careful siting, an unexpectedly large increase (from 5 to 20 times) in density can be achieved. Evidence is given to show that birds can remove substantial proportions of insect pest populations when these populations are low. Their most important effect, therefore, may be in preventing a plague from developing rather than in reducing one that has already occurred. It is considered, therefore, that efforts to increase the densities of birds are far from being wasted. The protection of animals, such as bats and ants, which also eat plague species of insects, is advocated.

77

Brush, T.;
Response of secondary cavity-nesting birds to manipulation of nest site availability.
M.S. Thesis, Arizona State Univ., Tempe 35 p. 1981

KEYWORDS:

ABSTRACT: not reviewed

78

Brush, T.; Anderson, B.W.;Ohmart, R.D.
Habitat selection related to resource availability among cavity-nesting birds.
Pp. 88-98 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: snags;avian ecology;avian density;cavity-nesting birds;habitat selection;foraging behavior;Colorado USA

ABSTRACT: Variation in snag species and abundance appeared to explain most of the habitat selection patterns observed in five cavity-nesting riparian species over a three-year period. All species except Ash-throated Flycatchers were most common in areas with cottonwood or willow snags, which have relatively soft wood and are preferred nest sites. Classification of habitats on the basis of nest-site characteristics was useful and should be considered in other habitat selection studies.

79

Bryant, A.A.;
Influence of selective logging on red-shouldered hawks, Buteo lineatus, in Waterloo Region Ontario, 1953-1978.

Can. Field. Nat. 100:520-525 1986

KEYWORDS: red-shouldered hawk;habitat disturbance;selective logging;tree characteristics;habitat description;territory abandonment;nest trees;management implications;Ontario

ABSTRACT: Nest records and aerial photographs spanning the period 1953-1978 were analysed to identify land-use changes associated with territory abandonment by Red-shouldered Hawks or the replacement of that species by Red-tailed Hawks. Incursions by Red-tailed Hawks were strongly associated with reductions in mean tree density and tree-crown diameter. This suggests that selective cutting in woodlots may result in the replacement of Red-shouldered Hawks by Red-tailed Hawks. Failure to maintain uncut buffer zones around traditional Red-shouldered Hawk nest sites may result in the local extirpation of this species.

80

Buckner, C.H.;
The biological side-effects of fenitrothion in forest ecosystems.
Information Report CC-X-67, Canadian Forestry Service, Dept. of Environ. 1975

KEYWORDS: insecticide;fenitrothion;biological side-effects;forest ecosystems;avian populations;post-spraying responses;Canada

ABSTRACT: Fenitrothion, applied as recommended for aerial control of forest insects in a single application of 3 oz./acre or in 2 applications of 2 oz/acre causes insect pest mortality for about 4-7 days. It degrades rapidly in water and soil, but may remain in trace amounts in certain plant foliage for several months. Although laboratory studies indicate that this insecticide is extremely toxic to honey bees, it causes no significant damage to commercial apiaries if applied as recommended. Forest amphibians are relatively insensitive to fenitrothion even at dosages several times the recommended level. Some species of small forest birds show slight mortality at applications above 4 oz/acre, and species in exposed niches such as yellowthroats, kinglets, Nashville and Tennessee warblers, and chipping sparrows show an increase in susceptibility as dosages increase. Other species, notably the whitethroated sparrow, are relatively insensitive to treatments even four times the recommended levels. Small mammals are less sensitive than birds: shrews first indicate impact at dosages beyond 6 oz/acre and rodents react at levels beyond 15 oz/acre. It is concluded that this insecticide presents only negligible environmental impact if used as directed.

81

Buckner, C.H.; McLeod, B.B.
Impact of aerial applications of Orthene (R) upon non-target organisms.
Information Report CC-X-104, Canadian Forestry Service, Dept. of Environ. 1975

KEYWORDS: insecticide;acephate;non-target organisms;avian population;post-spraying responses;Ontario;Quebec

ABSTRACT: Experimental applications of the chemical insecticide Orthene (R) (acephate) at two dosage rates were monitored for environmental disturbances to select non-target components of the ecosystem. Populations of small forest inhabitating birds, small mammals, amphibia and honey bees were monitored during the application of 0.56 kg AI/ha, and birds and small mammal populations monitored during application of 1.4 kg AI/ha. Population census data and field observations indicate that neither of these operations affected the organisms monitored except honey bees which suffered light short-term impact but quickly recovered.

82

Buckner, C.H.; McLeod, B.B.
Ecological impact studies of experimental and operational spruce budworm (Choristoneura fumiferana Clemens) control programs on selected non-target organisms in Quebec, 1976.
Information Report CC-X-137, Canadian Forestry Service, Dept. of Environ. 1977

KEYWORDS: spruce budworm control;fenithrothion;phosphamidon;non-target organisms;avian population;post-spraying responses;Quebec

ABSTRACT: Experimental and operational applications of fenitrothion and phosphamidon at varying dosage rates were monitored to assess the impact of these treatments upon selected non-target components of the environment. Early applications of fenitrothion did not affect honey bees, small forest songbirds or aquatic organisms. Subsequent treatments caused a noticeable but light impact upon the honey bee field force but did not harm the small forest bird or aquatic systems. Phosphamidon, where applied at dosage rates in excess of 0.140 AI/ha, caused mortality to the small forest songbird component, especially the ruby-crowned kinglet. Investigations into reports of pesticide damage to the environment by applications of fenitrothion, phosphamidon and aminocarb proved unfounded.

83

Buckner, C.H.; McLeod, B.B.;Gochnaver, T.A.
The impact of forest spraying on populations of small forest songbirds, small mammals and honeybees in the Menjou Depot Area of Quebec, 1973.
Information Report CC-X-84, Canadian Forestry Service, Dept. of Environ. 1974

KEYWORDS: spruce budworm control;insecticides;fenitrothion;Matacil (R);avian populations;post-spraying responses;Quebec

ABSTRACT: Studies of the ecological monitoring team of the Chemical Control Research Institute focused attention to the control operations for spruce budworm, in the Menjou Depot Area of Quebec in 1973. The area was treated first with fenitrothion and with Matacil (R) about 10 days later. Bird and mammal populations, subjected to both applications, were not affected by the treatments. Honey bees were subjected only to the Matacil (R) treatment; moderate mortality occurred to the worker force but the hives recovered quickly and no long-term damage ensued.

84

Buckner, C.H.; McLeod, B.B.;Kingsbury, P.D.
Studies of the impact of the carbamate insecticide Matacil (R) on components of forest ecosystems.
Information Report CC-X-91, Canadian Forestry Service, Dept. of Environ. 1975

KEYWORDS: insecticide;carbamate;non-target organisms;avian populations;post-spraying responses;Canada

ABSTRACT: The impact of the carbamate insecticide MATACIL (R) was studied on various components of the ecosystem in experimental and operational treatments in eastern Canada during the years 1971-1974. Dosage rates ranged from 52 g/ha (3/4 oz/acre) to 105 g/ha (1.5 ox/acre) of active ingredient. Particular emphasis was placed upon the effects of the chemical on small forest songbirds, small mammal, honey bees, amphibians and components of the aquatic ecosystem. At these dosage rates, little environmental impact was measured. There is some evidence that certain of the exposed songbirds such as ruby-crowned kinglets, black and white warblers, bay-breasted warblers, and yellowthroats were slightly affected by the treatments. Bees were subjected to adult forager knock-down but the effects were not lasting and the recovery was rapid. There was no observable impact on small mammals or amphibians. Minimal disturbance to aquatic organisms was noted, with stonefly nymphs the only groups suffering significant impact. It was concluded that at the application rates studied no serious or lasting ecological effects of the treatments could be discerned.

85

Buckner, C.H.; McLeod, B.B.;Kingsbury, P.D.
Accident investigation activities of the ecological impact team in forest areas treated with insecticide in 1975.
Information Report CC-X-103, Canadian Forestry Service, Dept. of Environ. 1975

KEYWORDS: insecticides;non-target organisms;phosphamidon;avian populations;post-spraying responses;Quebec;New Brunswick

ABSTRACT: Numerous reported incidents of insecticide poisoning on non-target organisms by forest insect control programs were investigated. Monitoring of the environment at the sites of accidental spills was also carried out in 1975. The reported insecticide poisoning of birds and fish resulting from a forest insect control operation employing phosphamidon (Dimecron) at the dosage rate of 140 a AI/ha was investigated in an area near Gaspe, Quebec. Populations of birds and aquatic bottom fauna were censused in treated and untreated areas. The area around Lac Bazire was searched for evidence of a recent fish kill. Samples of soil, foliage, water and birds were collected from treated areas and analysed for insecticide residues. No evidence of insecticide damage to birds, fish or aquatic bottom fauna was found. Dimecron residues persisted in samples of foliage, soil and water 12 days after application.

86

Buckner, C.H.; McLeod, B.B.;Kingsbury, P.D.
Insecticide impact and residue studies on northern Vancouver Island. 1973
Information Report CC-X-90. Canadian Forestry Service, Dept. of Environ. 1975

KEYWORDS: insecticides;fenitrothion;avian populations;post-spraying responses;DDT residues;British Columbia

ABSTRACT: These monitoring studies indicate that the fenitrothion treatment had no effect on the small songbird, small mammal, forest slug or aquatic fauna complexes in the areas studied. DDT residues within the 1957 spray area were found to have dropped to background levels in soil, mouse brains, forest slugs and fish. Examination of past salmon run estimates showed that the impact of the 1957 DDT treatment on salmon populations wasn't noticeable in terms of the number of adult salmon from this year class returning to spawn in later years.

87

Buckner, C.H.; McLeod, B.B.;Kingsbury, P.D.
The effect of an experimental application of Dimlin upon selected forest fauna.
Information Report CC-X-97, Canadian Forestry Service, Dept. of Environ. 1975

KEYWORDS: insecticide;Dimlin;avian populations;post-spraying responses;Ontario

ABSTRACT: *The impact of the insecticide Dimilin was studied on several components of the forest ecosystem in an experimental aerial application of 350 g/ha in 1975. Songbird populations were assessed daily on treated and untreated plots for 5 days prior to and continuing for 5 days after the application of Dimlin. Breeding territories were mapped and all sighted birds recorded on 4 hectare plots. On the day of insecticide treatment, plot searches were conducted to recover any sick, dead or dying birds. A total of 37 species of birds representing 13 families were recorded on the treatment plot and 36 species representing 13 families recorded on the untreated control plot. Daily population fluctuations were relatively small and the post spray daily average populations show a slight decline on both plots probably as a result of having to carry out population censuses on days in inclement weather. Pre and post treatment territories exhibit little variation. It is concluded that the treatment had no observable effect on the avian population.

88

Buckner, C.H.; McLeod, B.B.;Lidstone, R.G.
Environmental impact studies of spruce budworm (Choristomeura fumiferana Clemens) control programmes in New Brunswick in 1976.
Information Report CC-X-135, Canadian Forestry Service, Dept. of Environ. 1976

KEYWORDS: spruce budworm control;phosphamidon;acephate;carbaryl;larvicide;adulticide;avian population;post-spraying responses;New Brunswick

ABSTRACT: Immediate and short-term consequences of trials upon selected not-target organisms were studied. Phosphamidon employed as a larvicide at dosage rates in excess of 0.140 kg AI/ha proved to be harmful to the small forest bird complex but did not affect this group when applied as a budworm adulticide in multiple applications of 0.070 AI/ha. Aquatic organisms in streams and native small mammals were not affected by the phosphamidon trials. Acephate and carbaryl did not affect birds when applied as a larvicide at varying dosage rates. Aminocarb applied as an adulticide did not cause any mortality to the avian complex or affect benthic organisms in a test stream. Four operational blocks treated with two applications of fenitrothion at the emitted dosage rate of 0.210 kg AI were monitored. Breeding bird populations were not affected but variations in age class structure and sex ratio of Vigors were recorded. Benthic organisms in a fenitrothion treated stream decreased after the first application but showed partial recovery after the second application.

89

Buckner, C.H.; McLeod, B.B.;Ray, D.G.H.
The effect of operational application of various insecticides on small forest birds and mammals.
Information Report CC-X-43, Canadian Forestry Service, Environment Canada. 1973

KEYWORDS: spruce budworm control;insecticides;avian populations;post-spraying responses;Canada

ABSTRACT: *Analysis of the data received from the breeding bird plots would indicate that under the conditions of application no detectable harm resulted from the experimental spray programs.

90

Buckner, C.H.; Sarazin, R.
Studies of the environmental impact of the 1974 spruce budworm control operation in Quebec.
Information Report CC-X-93, Canadian Forestry Service, Dept. of Environ. 1975

KEYWORDS: insecticides;fenitrothion;Matacil (R);Zectran (R);avian populations;post-spraying responses;Quebec

ABSTRACT: The impact of several insecticides on various components of forest ecosystems was studied during operational spraying against spruce budworm in western Quebec in 1974. Dosage rates for the insecticides emitted were 52 g/ha (3/4 oz/acre) for MATACIL (R) and ZECTRAN (R), 280 g/ha (4 oz/acre) for Bacillus thuringiensis (B.t.) and 140 g/ha (2 oz/acre) for fenitrothion. Particular emphasis was placed upon monitoring the effects of these insecticides on populations of small forest songbirds, small mammals, honey bees and components of aquatic ecosystems. At these dosage rates, measurable environmental impact was minimal. Tennessee warbler, Vermivora pergrina (Wilson) populations were lightly affected by fenitrothion as were those to black and white warbler. Double applications using fenitrothion followed by ZECTRAN (R) slightly depressed populations of solitary vireo, after the fenitrothion treatment. In areas treated with MATACIL (R) there was an apparent reduction in populations of ruby-crowned kinglets and several species of warblers. There is no evidence of impact upon the small mammal component present in the treatment areas. Honey bees were not affected by an early application of fenitrothion and were only slightly affected by the second treatment. Colonies treated with ZECTRAN (R) were only lightly affected. Few effects were found on aquatic insect populations within the insecticide treated areas. MATACIL (R) selectively affected stonefly nymph populations.

91

Bull, E.L.;
Specialized habitat requirements of birds: snag management, old growth, and riparian habitat
Pp. 74-82 in: R.M. DeGraaf, tech. coord. Proceedings of the workshop on nongame bird habitat management in the coniferous forests of the western United States. USDA For. Serv. Gen. Tech. Rept. PNW-64. 1978

KEYWORDS: snags;old-growth forests;riparian habitat;nongame birds;woodpeckers;management implications

ABSTRACT: Snags, old-growth forests, and riparian habitat are unique components of forest ecosystems. Their value, characteristics, and management as they relate to nongame birds are discussed.

92

Bull, E.L.;
Longevity of snags and their use by woodpeckers.
Pp. 64-67 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: snags;snag characteristics;snag longevity;woodpecker habitat;management implications;Oregon USA

ABSTRACT: Fifty percent of the ponderosa pine snags and 38% of the lodgepole pine snags were standing 8 years after being killed by the mountain pine beetle in northeastern Oregon. Trees greater than 50 cm dbh stood longer than smaller trees. Woodpeckers excavated cavities in 15 of the 186 ponderosa pine snags 3 to 8 years after the trees died.

93

Bull, E.L.; Henjum, M.G.;Anderson, R.G.
Nest platforms for great gray owls.
Pp. 87-90 In: R.W. Nero, R.J. Clark, R.J. Knapton and R.H. Hamre, eds. Biology and conservation of northern forest owls, symposium proceedings. USDA For. Serv. Gen. Tech. Rept. RM-142 309 pp. 1987

KEYWORDS: great gray owls;nest platforms;habitat management;management implications

ABSTRACT: During 1983-1986, 12 great gray owl pairs nested on artificial platforms in northeastern Oregon. Platforms put up 15 m were preferred over those platforms put up 9 m. Nest platforms were preferred over nest boxes. Each platform cost $40 to construct and mount.

94

Bull, E.L.; Meslow, E.C.
Habitat requirements of the Pileated Woodpecker in northeastern Oregon.
J. For. 75:335-337 1977

KEYWORDS: pileated woodpecker;habitat requirements;nest sites;foraging behaviour;density;management recommendations;Oregon USA

ABSTRACT: **Nesting, feeding, and territorial activities of the pileated woodpecker were observed in the spring and summer of 1973 and 1974 in northeastern Oregon. The 13 nests found in a 28000 acre area were in ponderosa pine and western larch snags greater than 23 inches d.b.h.. Pileated woodpeckers fed primarily in dead wood in snags, logs and naturally created stumps. Both nesting and feeding sites were in concentrations of snags found in the most dense forest types. Minimum nesting territories were estimated at 320 acres.

95

Bull, E.L.; Partridge, A.D.
Methods of killing trees for use by cavity nesters.
Widl. Soc. Bull 14:142-146 1986

KEYWORDS: habitat management;snag formation;cavity-nesting birds;management costs;techniques

ABSTRACT: **Several different methods of killing trees for use by cavity nesters, and the associated cost for each method are described. Management recommendations are given.

96

Bull, E.L.; Partridge, A.D.;Williams, W.G.
Creating snags with explosives.
USDA Forest Service, Pacific Northwest Forest and Range Experiment Station. Research Note PNW-393. 4 p. 1981

KEYWORDS: habitat management;snag formation;explosives;management costs;techniques

ABSTRACT: The tops of ponderosa pine (Pinus ponderosa) trees were blown off with dynamite to create nest sites for cavity necting wildlife. The procedure included: drilling a hole almost through the trunk, inserting the dynamite, and setting the charge with primacord and fuse. Trees were simultaneously innoculated with a decay organism. The average cost was $30 per tree.

97

Bull, E.L.; Peterson, S.R.;Thomas, J.W.
Resource partitioning among woodpeckers in northeastern Oregon.
USDA For. Serv. Pacific Northwest Res. Stn. Res. Note PNW-444. 19 p 1986

KEYWORDS: woodpeckers;resource partitioning;foraging behaviour;competition;tree use;cavity-tree characteristics;management implications;Oregon USA

ABSTRACT: Eight species of woodpeckers coexist in conifer forests in northern Oregon: Northern flicker, yellow-bellied and Williamson's sapsuckers, and pileated , hairy, white-headed, three-toed, and black-backed woodpeckers. Tree diameter was the most important factor considered in selection of nest trees by northern flickers, Williamson's sapsuckers, and pileated and hairy woodpeckers. These species partitioned the nest habitat by occupying different forest stands or conditions of nest trees. Pileated woodpeckers occurred in grand fir stands and nested in snags dead 10 or more years. The same stands were used by Williamson's sapsuckers which nested in live or recently dead trees. Northern flickers and hairy woodpeckers nested in ponderosa pine forests but flickers used larger snags. Foraging habitat and strategies differed. Only the pileated woodpecker excavated extensively in dead wood-particularly in downed wood and in grand fir forests. Northern flickers fed on the ground in open forests or grasslands. Live trees were used by Williamson's sapsuckers and white-headed woodpeckers. Sapsuckers drilled sapwells in Douglas-fir and the white-headed woodpecker gleaned on ponderosa pine trunks and ate seeds. The remaining three species foraged by scaling, but the three-toed woodpecker fed exclusively in lodgepole pine stands. The hairy and black-backed woodpeckers scaled on similar trees in ponderosa pine stands. Hairy woodpeckers occasionally foraged on limbs and cones; black-backed woodpeckers used neither. Theoretically, nesting should have occurred when maximum food was available; however, hairy and black-backed woodpeckers, species most similar in their feeding habitat and strategies, fledged their young the earliest and the latest, respectively. This temporal separation could reduce competition.

98

Bull, E.L.; Twombly, A.D.;Quigley, T.M.
Perpetuating snags in managed conifer forests at the Blue Mountains, Oregon.
Pp. 325-336 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: snags;cavity-nesting birds;cavity-tree characteristics;techniques: snag formation;silvicultural systems;even-aged management;uneven-aged management;clearcutting;shelterwood;economics;management implications

ABSTRACT: Both quality and quantity of snags must be considered when managing cavity nesters. Large snags with evidence of decay, existing cavities, or both are frequently used as nest trees. To maintain woodpecker populations at 70% of their potential, 3.91 snags per ha (1.58 per acre) are required. Such numbers can be maintained throughout a rotation by leaving enough live trees that die or are killed to provide snags when, where, and in needed numbers.

99

Bunnell, F.L.; Allaye-Chan, A.
Potential of winter range reserves for ungulates as habitat for cavity-nesting birds.
Pp. 357-365. In: W.R. Meehan, T.R. Merrell, Jr., and T.A. Hanley, eds. Proceedings of a symposium on fish and wildlife relationships in old-growth forest, American Institute of Fishery Research Biologists Northwest Section, The Wildlife Society Alaska Council on Science and Technology held in Juneau, Alaska, 12-15 April 1982. 1984

KEYWORDS: winter range reserves;snags;cavity-nesting birds;cavity-tree characteristics;old-growth forest;second-growth forest;management implications;British Columbia

ABSTRACT: Two old-growth stands reserved as winter range for ungulates, one old-growth riparian forest, and one second-growth forest in the same community were sampled for snag density. Height; dbh; limb, twig and top condition; percentage bark loss; and species were recorded. Total snag density did not differ significantly between old and second growth forests, and ranged from 33.9 to 117/ha. Snags with cavities (active) were less abundant in second growth (0.4/ha compared to 2.2 to 14.8/ha). In old growth, active snags had significantly greater dbh and height than inactive snags (P<=0.05); second growth snags had small dimensions than inactive old growth snags(P<=0.01) and only 1.3% active. Cavities of different sizes generally occurred in snags of different sizes (P<=0.05). Proposed forestry practices would greatly reduce the ability of forests to provide cavity sites. Minimum dimensions were demonstrated to be inadequate as snag retention guidelines. Old growth, winter range reserves provided suitable habitat for cavity nesting birds.

100

Bunnell, F.L.; Eastman, D.S.
Effects of forest management practices on wildlife in the forests of British Columbia.
Pp. 631-688 in: Proceedings of the XVI IUFRO Congress. Norwegian IUFRO Congress Committee, c/o Norwegian Forest Research Institute, N-1432 As-NLH, Norway. 1976

KEYWORDS: forest management;habitat disturbance;forest succession;model;impact evaluation;silviculture;clear-cutting;selective logging;residue;slash burning;snag removal/culling;scarification;pesticides;fire suppression;thinning;logging system;management implications

ABSTRACT: In British Columbia, a wide variety of mammals, birds, amphibians and fish are directly or indirectly influenced by the nature of the forest cover present. The diversity of forestry management practice on each wildlife species. Acknowledging this diversity, a general model of the changes in major resources required by ten wildlife species following complete removal of the tree overstory is presented. The resources considered are energy, nutrients, water, temporary shelter, habitation, escape cover and space. The general model is evaluated for specific resources required by selected species and its applicability and limitations are documented. Because it presents a general pattern resulting from autogenic, secondary succession, the model can be used as a framework to examine influences of particular forest management practices on wildlife species. The value of the model is that it provides a device for relating scattered observations on many wildlife species in many forest types and offers a vehicle for extrapolating generalities to areas that have not been studied extensively. It thus provides a forest manager with a convenient device for evaluating the potential impacts of proposed management practices.

101

Bureau of Land Management, ;
Final Environmental Statement for Timber Management.
Department of the Interior, U.S.A. XI-136 pp

KEYWORDS: timber management;logging;environmental effects;vegetation;wildlife;USA

ABSTRACT: A report which discusses environmental effects of timber management on a broad scale. Includes sections of the impact of various logging systems on vegetation and wildlife.

102

Burke, M.;
Bald eagle nesting habitat improved with silvicultural manipulation in northeastern California.
Pp. 101-105 in: D.M. Bird, ed. Biology and Management of Bald Eagles and Ospreys. Harpell Press, Ste. Anne de Bellvue, Quebec. 325 pp. 1983

KEYWORDS: bald eagle;habitat improvement;nesting habitat;silvicultural manipulation;management implications;California USA

ABSTRACT: Bald Eagle nesting habitat was improved using silvicultural methods to provide required tree and stand types. Treatments included thinning and regenerating stands. Approximately 200 ha were treated in conjunction with 2 timber sales. Five nesting territories were impacted by the plan.

103

Burr, R.M.;
Logged Engelmann's spruce-alpine fir forest.
Audubon Field Notes 23:756 1969

KEYWORDS: avian diversity;avian density;logging: 20 yr old;spruce-alpine fir forest;Utah USA

ABSTRACT: **Avian species and densities were recorded on a 7-8 ha plot, a 20-year old logged site, in a Engelmann spruce-alpine fir forest. The tree canopy consisted of 69% Engelmann spruce, 24% alpine fir, and 7% aspen. Dead standing trees comprised 18% of the total basal area. Twelve species were recorded with densities varying from 19 to 167 individuals per sq km. Mountain Chickadee, Ruby-crowned Kinglet and Chipping sparrow nested in the area. There were fewer flycatcher territories in the logged area than in the neighboring mature forest. The number of woodpeckers was considerably higher in the logged forest than in unlogged areas.

104

Burr, R.M.; Jones, R.E.
The influence of parkland habitat management on birds in Delaware.
N. Amer. Wildl. and Nat. Res. Con. Trans. 33:299-306 1968

KEYWORDS: parkland management;urban woodlots;urban impact;second growth forest;bird species diversity;breeding bird populations;bird densities;Delaware USA

ABSTRACT: *Recent rapid increase in urbanization in the United States has excited public concern about the effects it will have on bird and mammal populations. The University of Delaware has initiated several projects concerning urban impact on wildlife. The objective of this project was to determine some effects certain parkland management procedures and usage have on the occurrence of birds in urban wooded areas. Parkland management coupled with heavy human use apparently affects breeding bird populations by: 1)decreasing the diversity of bird species, and 2) increasing the nesting height of those birds nesting in shrubbery. The practice of shrub removal was considered by the authors to be of consequence in changing the nesting habits of some interesting bird species. When possible, areas of brush should be left to encourage these birds for the enjoyment of persons using parkland areas. Bird feeders appeared to be the main factor which increased the numbers and diversity of wintering birds in the managed woodlands.

105

Capen, D.E., ed.;
The use of multivariate statistics in studies of wildlife habitat.
USDA For. Serv., Gen. Tech. Rep. RM-87. 249 p. 1981

KEYWORDS: wildlife habitat;multivariate statistics;bird-habitat relationships

ABSTRACT: *This symposium presented papers from a meeting that was organized to bring research biologists and statisticians together to discuss multivariate methods and their applications to studies of wildlife habitat.

106

Capen, D.E.;
Management of northern pine forests for nongame birds.
Pp. 90-109 in: R.M. DeGraaf and K.E. Evans, tech. coord. Management of north central and northeastern forests for nongame birds. Workshop Proc., Jan 23-25, 1979, Minneapolis, Minnesota. USDA For. Serv. Gen. Tech. Rept. NC-51. 1979

KEYWORDS: avian ecology;avian diversity;bird-habitat relationships;forest management;silviculture;clear cutting;even-aged management;thinning;management implications;pine forest;North America

ABSTRACT: Forests of white, red, jack, and pitch pine may be managed to provide productive habitat for nongame birds.Diverse avian communities often inhabit stands of pine, but few species are restricted to pine forests.

Single-species and multi-species wildlife management philosophies are discussed and are related to four principles of managing forest habitat for nongame birds. Even-aged silviculture is recognized as the predominant harvesting practice in pine forests. Forest management which promotes natural regeneration, hardwood understories, and old-growth stands is recommended to enhance habitat for birds. The endangered Kirtland's warbler nests only in young stands of jack pine and is a reminder that pine forests should not be overlooked as wildlife habitat.

107

Capen, D.E.; Cooper, R.J.;DeGraaf, D.M.
Nongame birds of northeastern forests: population trends, habitat associations, research needs.
Trans. Northeast Fish and Wildl. Conf. 36:69-75 1979

KEYWORDS: forest birds;nongame birds;population trends;habitat;forest succession;forest management;northeastern forests

ABSTRACT: As part of a nationwide assessment of wildlife, population trends from 1968 to 1977 were determined for 31 species of forest-dwelling birds in the Northeast. Changes in populations for these species were related to 8 forest ecosystems and 4 stocking classes within each ecosystem. Six species exhibited noticeable positive population trends; 11 species showed negative trends; and 14 species were found to show no noticeable change in numbers. Downward population trends were generally related to early successional stages of forest habitats. Additional research to define the associations of nongame birds with forest habitat types and to relate population trends to habitat changes is needed.

108

Capen, D.E.; Fenwick, J.W.;Inkley, D.B.;Boynton, A.C.
Multivariate models of songbird habitat in New England forests.
Pp. 171-179 in: J. Verner, M. Morrison and C.J. Ralph eds. Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. Univ. of Wisconsin Press, Madison, WI. 1986

KEYWORDS: habitat assessment;habitat suitability;multivariate models;bird-habitat relationships;discriminant function analysis;logistic regression;model evaluation;hardwood forest

ABSTRACT: Three studies led to the development of species habitat models for songbirds in a northern hardwood forest. Each study was designed to discriminate between used and unused study plots, but plots were assigned to groups based on different criteria: bird use, territory site, or nest site. Models which predicted used and unused potential habitat were developed by discriminant function analysis and logistic regression, and then evaluated by a jackknife procedure, cross-validation, and classification of independent data. Models for three species of birds are presented to illustrate unacceptable results of classifying independent data. Reasons for failure of these models include inappropriate design, multicollinearity of habitat variables, and inadequate sampling of habitat diversity. Models for a fourth species, the red-eyed vireo, illustrate some inconsistency, but two of four models show reasonable rates of classification.

109

Carbyn, L.N.;
Densities and biomass relationships of birds nesting in boreal forest habitats.
Arctic 24:51-61 1971

KEYWORDS: bird densities;bird biomass;migratory birds;habitat preference;boreal forest;NWT

ABSTRACT: A spot mapping technique was applied to obtain quantitative data on bird populations on 25 acre (10 ha) plots in northern boreal forest habitats. The number of breeding passerines varied from 15 to 42 pairs per plot. The number of species varied from 6 to 11 breeding passerines and 4 to 8 non-passerines and non-breeding passerines. Biomass of the breeding passerines ranged from 3100 to 5496 grams per 100 acres (40 ha.). Members of the Fringillidae family contributed the highest percentage of the total avian biomass, followed by Turididae, Parluidae, Bombycillidae, Sylviidae, Paridae and Tyrannidae.

110

Carey, A.B.;
Cavities in trees in hardwood forests.
1983

KEYWORDS: cavity trees;cavity tree characteristics;bird use;cavity tree formation;hardwood forest

ABSTRACT: The effectiveness of forest management in ensuring viable populations of cavity-using wildlife will depend on the extent to which managers understand the nature of the cavity resource and the patterns of abundance of cavity trees. To gain such an understanding for Appalachian deciduous forests, I sampled 31 oak-hickory stands (47-120 years old) and 12 maple-beech-birch stands (61-206 years old). Over 4,400 trees were measured to describe the stands and more than 80 ha containing 39,000 trees were searched for cavities. Abundance of trees with cavities was highly variable even among very similar forests; much of the variability was unrelated to age, diameter at breast height (dbh), site index, or other stand or topographic features. Random processes played major roles. Standing dead trees peaked at 50-70 years. Cavity tree abundance (4-9/ha in the oak-hickory, 4-17/ha in the maple-beech-birch) was lower than called for by current management recommendations. Snags (dead or partly dead trees) were more abundant than currently recommended; the value of snags in evaluating habitat is questionable. The two forest types differed markedly in the types of cavity trees, abundance of different kinds of cavities, and the types of management activities that would be appropriate.

111

Carey, A.B.; Gill, J.D.
Direct habitat improvements - some recent advances.
Pp. 80-87 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: techniques;habitat improvement;nest-boxes;artificial trees;artificial cavities;management implications

ABSTRACT: Den boxes can be made smaller, more accessible, and more resistant to predators by adding an inside shelf just below the entrance. Boxes placed on the lee sides of trees were preferred by squirrels in winter but not in spring or summer. And den boxes can raise the carrying capacity of young forest for sciurids. Using a chain saw to create tree cavities to be covered with a wooden faceplate is more efficient than routing dens with a drill or creating dens with a chain saw and chisel. Small woodpeckers will excavate cavities in styrofoam cylinders. These "plastic trees" offer some intriguing management and research applications.

112

Carey, A.B.; Sanderson, H.R.
Routing to accelerate tree-cavity formation.
Wildl. Soc. Bull. 9:14-21 1981

KEYWORDS: technique: cavity formation;routing;cavity trees;cavity use;habitat management;management implications

ABSTRACT: Tree routing, as a means of accelerating the formation of cavities in trees, has potential as a habitat management technique for a variety of cavity-nesting wildlife species. To evaluate routing as a technique, cavities were routed in 48 red maples, 48 northern oaks and 48 white oaks. After 3 years, 139 trees were still structurally sound, but 5 red maples had fractured at the routing site. About a third of the cavities contained standing water; 18% were closed by callus. Partially closed cavities (about 80% of all cavities) were used by southern flying squirrels for feeding and denning. Further research is needed before routing can be recommended as a habitat management technique.

113

Carmichael, D.B. Jr.; Guynn, D.C., Jr.
Snag density and utilization by wildlife in the upper Piedmont of South Carolina.
Pp. 107-110 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: snag density;cavity-trees;snag selection;cavity-nesting birds;management implications;South Carolina USA

ABSTRACT: Snag densities were estimated for major forest types of the Clemson Experimental Forest, in the upper Piedmont of South Carolina. Two-hundred 0.1 ha plots were established in various aged stands of cove hardwood, upland hardwood, pine-hardwood, and pine plantations. Climbable snags containing cavities were inspected to determine use by wildlife during warm months (may-September) and again during cold months (November-March). Mean snag densities were 50.3 snags per ha for upland hardwoods, 37.3 snags per ha for cove hardwoods, 31.2 snags per ha for pine-hardwoods, and 21.3 snags per ha for pine plantations. Cavities occurred in only 8.8% of all snags tallies. Preliminary results indicate that more than 35% of snags with cavities were utilized by southern flying squirrels.

114

Carrow, J.R., ed., ;
Aerial spraying operations against blackheaded budworm on Vancouver Island, 1973.
Information Report BC-X-101, Pacific Forest Research Center, Environment Canada. 1974

KEYWORDS: aerial spraying;fenitrothion;blackheaded budworm;avian populations;post-spraying responses;British Columbia

ABSTRACT: In June 1973, an aerial spray project was conducted by the Council of Forest Industries of British Columbia and the Province of British Columbia to protect 29,000 acres of hemlock forest on northern Vancouver Island from additional defoliation by an outbreak of blackheaded budworm. Environment Canada provided entomological and technical advice and assessed the effectiveness of the operation, as well as its effects on non-target organisms. The formulation used was 2 oz fenitrothion in 20 oz water per acre applied twice at a four-day interval. Spraying resulted in 80% control of blackheaded budworm in young stands (up to 40 ft) and 46% control in older stands (over 100 ft). The foliage protection value of the spray was difficult to determine accurately because the larval population collapsed prior to heavy feeding; however, spraying resulted in a 14% improvement in the crown condition of young stands. The budworm population experienced a sudden collapse, due to natural causes, shortly after spraying and the evidence suggests that it was associated with 11 days of continuous rain and cool temperatures during early July. Spray assessment indicated a very low ground level deposit and spray drift onto the leave strips surrounding fish-bearing waters; trace amounts of spray were also detected up to six miles from the spray boundary. Monitoring of the effects of the operation on non-target organisms revealed that populations of juvenile salmon, songbirds and small mammals suffered no immediate ill effects. However, there was considerable mortality of several families of aquatic and terrestrial insects.

115

Casey, D.; Hein, D.
Effects of heavy browsing on a bird community in deciduous forest.
J. Wildl. Manage. 47:829-836 1983

KEYWORDS: bird community;bird species diversity;habitat management;browsing effects;deciduous forest;Pennsylvania USA

ABSTRACT: *The objective of this study was to assess the impact of high-density ungulate populations on 5 parameters (species composition, relative abundance, absolute abundance, bird species diversity, density of breeding pairs) of a community of birds in an eastern deciduous forest. The results suggest that long-term management for high-density populations of ungulates will result in changes in the breeding bird community. These changes were mainly attributed to habitat alteration caused by overbrowsing.

116

Chasko, G.G.; Gates, J.E.
Avian habitat suitability along a transmission-line corridor in an oak-hickory forest region.
Wildl. Monogr. 82:1-41 1982

KEYWORDS: habitat suitability;transmission line-corridor;herbicide treatment;edge effects;habitat heterogeneity;songbirds;nesting success;model;management implications;Maryland USA

ABSTRACT: A study of open-nesting passerines was made at 2 sites along a 138 kV transmission-line corridor through a forested region of Allegany County, Maryland, during 1978 and 1979. One site (Green Ridge) was maintained primarily as grassland habitat by mowing; the other site (Warrior Mountain) was kept as shrubland habitat by periodic selective herbicide spraying. Patterns of fledging success and spatial distribution of nests were assessed in each habitat type in relation to the corridor, corridor-forest edge, and the adjacent forest habitat. Important features of the nest microhabitat that may influence nest success were evaluated for both corridor and forest nesting birds. At Green Ridge, nests were more abundant in the middle of the corridor than near the edge. However, higher percentages of nests occurred in the adjacent forest within 20 m of the corridor-forest edge than farther into the forest interior. Although several nests of forest species were located near the edge , these birds used the corridor minimally. A vegetative profile across the edge indicated that the corridor-forest interface was very abrupt at this site. The distinct edge functioned more as a barrier between the 2 habitats than as a transition zone and served as a natural territorial boundary for many bird species. The corridor was dominated by mixed-habitat bird species rather than grassland birds. The few isolated shrub patches occurring in the grassy corridor provided "habitat islands" where nest density and fledging success were high. Those nests occurring in the herbaceous portion of the corridor were generally unsuccessful. Trends in fledging success of forest nesting birds with distance from the edge were not obvious; however, predation losses did tend to be concentrated near the edge. At Warrior Mountain, corridor nests tended to be evenly distributed across the corridor in the 1st breeding season and more abundant in the middle in the 2nd season following herbicide application. Slightly higher percentages of nests also occurred in the forest within 20 m of the corridor-forest edge. At this site, the corridor-forest interface was less distinct because of the shrub composition of the corridor. This situation resulted in greater overlap between mixed-habitat and forest bird species than occurred at Green Ridge. Increased fledging success of corridor nesting birds was related to increased patchiness of the shrub vegetation. Fledging success decreased as the habitat became more homogeneous. In the forest, higher fledging success was associated with increasing distance from the edge. This was in part related to lower predation losses farther from the edge. There was also some indication that hatching failures decreased with the length of time since herbicide application at this site. Discriminant function analysis of nest microhabitats was used to distinguish between successful and unsuccessful nests in the corridor and forest. Results confirmed our field observations on the association of successful corridor nests with vegetation heterogeneity or patchiness, and successful forest nests with mature undisturbed forest habitat and concealing cover around the nest. Based on the predictability of our discriminant function models, mixed-habitat bird species appeared to be more general in their nest microhabitat requirements than forest birds. Because shrug patches functioned as refugia for nesting mixed-habitat birds, patchy systems should have a higher fitness than homogeneous systems. Predators apparently were not able to exploit the patchily distributed nests. Therefore, managing for increased vegetation heterogeneity in transmission-line corridors may be an important technique for increasing nest density and success of mixed-habitat bird species.

117

Cimon, N.;
A simple model to predict snag levels in managed forests.
Pp. 200-204 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: snag levels;managed forests;snag model;management implications

ABSTRACT: The need for quantitative estimates of snag levels is discussed. A simple model to predict snag levels in managed forests is developed. Projections of standing snags in two diameter classes for a typical managed stand are developed. The model, once verified, may prove its usefulness when incorporated within existing stand simulations.

118

Clark, K.; Euler, D.;Armstrong, E.
Habitat associations of breeding birds in cottage and natural areas of Central Ontario.
Wilson Bulletin. 95:77-96 1983

KEYWORDS: forest birds;breeding birds;habitat associations;habitat structure;principal component analysis;impact predictions;Ontario

ABSTRACT: *Habitat associations of breeding birds in central Ontario were determined by measuring habitat characteristics at singing posts and nest-sites and by using these variables in principal component and stepwise discriminant function analyses. These results were then used as baseline data to predict avian responses to habitat disturbance caused by cottage development. Three habitat variables were important in accounting for large proportions of the total variance in all analyses. These were canopy volume, tree density, and amount of understory. The consistent importance of these variables may be significant in avian habitat selection. Coniferous composition was important in the discriminant function analysis, and may be important as another measure of horizontal structuring of habitat. By interpreting the positions of each species along the discriminant function and principal component axes, habitat associations could be described and predictions made regarding the response of a species to habitat disturbance caused by cottage development. In Muskoka-Haliburton removal of the majority of vegetation around a cottage leaves breeding habitat for Song Sparrows and Robins. If some predominately coniferous vegetation is left, White-throated Sparrows will also occur. Phoebes and Pewees occur on the periphery of cottage clearings. Selective tree removal while leaving the rest of the vegetation undisturbed would create breeding habitat for Veerys, Black-throated Blue and Yellow-Rumped Warblers, and Red-eyed Vireos. Cottage lots that have been cleared and allowed to go through natural succession to the immature tree stage would create breeding habitat for Rose-breasted Grosbeaks, Swainson's Thrush, Black-throated Green and Black-and-White Warblers probably will not occur near cottages because they are intolerant of vegetation disturbance.

119

Cline, S.P.;
The characteristics and dynamics of snags in Douglas-fir forests of the Oregon Coast range.
M.S. Thesis. Oregon State Univ., Corvallis. 106 pp. 1977

KEYWORDS:

ABSTRACT: not reviewed

120

Cline, S.P.; Berg, A.B.;Wight, H.M.
Snag characteristics and dynamics in douglas-fir forests, Western Oregon.
J. Wildl. Manage. 44:773-786 1980

KEYWORDS: snag characteristics;snag decay;forest succession;managed stands;unmanaged stands;snag management;Douglas-fir;Oregon USA

ABSTRACT: We studied snags in 30 stands, 5-445 years old, of unmanaged and managed Douglas-fir in western Oregon to gain information about snag populations and status after logging. As snag production rates (snags/ha/year) declined from about 100 to 1, mean snag density decreased from 190 to 18/ha in age-classes 35 and 200+, respectively; remnant snags (formed in previous stands) represented 5-14% of current densities. Meanwhile, average snag dbh increased from 13 to 72 cm, and as dbh increased, snags stood longer. Douglas-fir was the dominant species among snags in all forest age-classes. Linear regression analysis showed a correlation (P<0.001) between snag age and deterioration; populations consisted of fewer young (sound) and old (highly decayed) than middle-aged (partially decayed) snags. Cluster analysis revealed 5 stages of deterioration based upon snag size and decay condition. In unmanaged stands, most (62%) snag populations were distributed randomly, but patches of snags were found in all age-classes. Fewer snags (P<0.001) remained after thinning and clear-cutting unmanaged forests, and natural snag production was disrupted. Large snags should be retained within forests managed over long (>200 year) rotations; in riparian forests; in extensively managed, slow-growing forests; and within intensively managed forests, safety permitting.

121
Cline, S.P.; Phillips, C.A.
Coarse woody debris and debris-dependent wildlife in logged and natural riparian zone forests - a western Oregon example.
Pp. 33-39 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: riparian forests;logging effects;rotation period;clearcutting;snags;residue;extirpation;avian diversity;management implications;Oregon USA

ABSTRACT: We conducted a reconnaissance study to determine some structural aspects of riparian zone forests and the effects of logging upon woody debris wildlife habitat. We also conducted a literature search to gather information upon the debris-dependent wildlife in riparian zone forests, and how they are influenced by timber management. This information was synthesized in a hypothetical example of snag management in the Coast Range of Oregon. We found that snag habitat of the larger woodpeckers was reduced by clearcutting and we predicted that shortened rotations in the future will reduce or even locally extirpate 20 bird and 5 mammal species. We calculated that the snag requirements of hole-nesting birds are not met using only snags in riparian zone buffer strips. An active program of dead tree management on upland areas is also necessary.

122
Conner, R.N.;
Snag management for cavity nesting birds.
Pp. 120-128 in: R.M. DeGraaf, tech. coord. Proc. of the Workshop: management of southern forests for nongame birds. Jan 24-26, 1978, Atlanta, Georgia. 1978

KEYWORDS: cavity-nesting birds;cavity-tree characteristics;snag management;rotation period;silviculture;timber harvest;management implications;USA

ABSTRACT: Availability of snags on forest lands affects abundance, diversity, and species richness of cavity nesting birds. The effect of timber rotations, harvesting techniques, and fungal heart rots on nest site availability is examined. Research needs are surveyed and management recommendations suggested.

123
Conner, R.N.;
Minimum standards and forest wildlife management.
Wildl. Soc. Bull. 7:293-296 1979

KEYWORDS: wildlife management;forest management;minimum standards;threatened/endangered species;management implications

ABSTRACT: I recommend that managers provide habitat as close as possible to the optimum for each important habitat variable for threatened and endangered species. For example, the mean age of loblolly pines with newly completed red-cockaded woodpecker cavities is 80.6 years. Based on this I suggest that in loblolly stands managed for this endangered species, the rotation age be set between 85 and 90 years or higher (depending on the range of trees necessary) to provide the optimum age range of suitable nest trees. By providing optimum quality trees for woodpeckers, or the optimum requirements of special habitat factors for other sensitive species, we may achieve the goal of multiple use without any gradual, negative effect on species we wish to preserve. In managing multiple-use areas for desired species that are not endangered, threatened, or sensitive, I suggest that we may be able to provide habitat in the range between a species mean and 1 standard deviation below the mean for important habitat factors without serious detrimental effects on the species.

124

Conner, R.N.;
Fire and cavity-nesting birds.
Pp. 61-66 in: Proc. symposium on prescribed fire and wildlife in southern forests. US. For. Serv., Southeast. For. Exp. Stat., SEFES-83-2 1981

KEYWORDS:

ABSTRACT: not reviewed

125

Conner, R.N.; Adkisson, C.S.
Eastern bluebirds nesting in clearcuts.
J. Wildl. Manage. 38:934-935 1974

KEYWORDS: bluebirds;clearcuts;post-logging response;forest succession;nesting density;snags;Virginia USA

ABSTRACT: *Observations of bluebirds in clearcuts in a mature oak-hickory forest exposed the possibility that modern clearcutting programs may create suitable nesting habitat. In different areas clearcuts 1-15 years previously were systematically searched for bluebirds nesting during May and June of 1973. Vocalizations of nesting pairs followed by observations of movements usually exposed the location of the nest tree. Seven of ten clearcuts contained an active bluebird nest. Three were located in 1 to 2 year old clearcuts which ranged from 11-32 ha. and were sparsely stocked with regeneration hardwood stems of about 1 m in height. Another three nests were found in 5 year old clearcuts which ranged from 16-20 ha. and were moderately stocked with hardwood stems 2 m in height. One nest was located in a 9 ha, 12 year old clearcut, densely stocked with 4-5 m trees. Bluebird nests were not present in three 10-15 year old clearcuts which were less than 12 ha. and densely stocked with 3-6 m hardwood stems. All seven nests were in standing snags 23.6+8.4 dbh that were 133.9+79.7 m from mature woodlands.

126

Conner, R.N.; Adkisson, C.S.
Effects of clearcutting on the diversity of breeding birds.
J. For. 73:781-785 1975

KEYWORDS: clear-cutting;forest succession;breeding birds diversity;bird species diversity;forest birds;habitat preference;mixed oak;Virginia USA

ABSTRACT: In mixed oak stands in southwestern Virginia, species diversity of breeding birds was the lowest in the 1-year-old clearcut and reached its highest level in the 7-year-old clearcut. Forest dwelling birds first appeared in the 12-year-old clearcut. Clearcutting provided nesting habitat for a greater diversity of birds than no cutting.

127

Conner, R.N.; Adkisson, C.S.
Discriminant function analysis: a possible aid in determining the impact of forest management on woodpeckers nesting habitat.
For. Sci. 22:122-127 1976

KEYWORDS: woodpeckers;habitat preference;nest site characteristics;management implications;Virginia USA

ABSTRACT: Measurements of basal area, density of stems, and canopy height were made on a total of 53 nest sites of downy, hairy , and pileated woodpeckers, and the common flicker. Two-group discriminant function analyses were calculated for each species using measurements of plots located randomly in a spectrum of selected habitat types in the study area. The analyses are discussed as possible aids in land management decisions and in management of endangered species.

128

Conner, R.N.; Crawford, H.S.
Woodpecker foraging in Appalachian Clearcuts.
J. of Forest. 72:564-566 1974

KEYWORDS: clearcutting;forest succession;woodpeckers;snags;foraging behavior;silviculture;Virginia USA

ABSTRACT: In mixed oak stands in southwestern Virginia, downy and hairy woodpeckers fed on insects located under the bark of the abundant logging debris left one year after clearcutting. Flickers fed on ants and fruits found on the ground in an area clearcut five years previously. A 12-year-old clearcut area was used only occasionally by all these birds. A mature, uneven-sized stand was used substantially by downy, hairy, and pileated woodpeckers but not by the common flicker. Alternative forest management practices are proposed to enhance forest habitat for woodpeckers.

129

Conner, R.N.; Dickson, J.G.;Locke, B.A.
Herbicide-killed trees infected by fungi: potential cavity sites for woodpeckers.
Wildl. Soc. Bull. 9: 308-310. 1981

KEYWORDS: woodpeckers;cavity-sites;fungi infection;herbicide-killed trees;management implications

ABSTRACT: Woodpeckers and other cavity nesting birds can be helpful in the control of harmful forest insects. But cavity nesting birds need suitable nest and roost trees in order to excavate or find cavities. An abundant source of these trees may be provided by herbicide application on hardwoods during timber stand improvement operations.

130

Conner, R.N.; Dickson, J.G.;Locke, B.A.;Segelquist, C.A.
Vegetation characteristics important to common songbirds in east Texas.
Wilson Bulletin. 95:349-361 1983

KEYWORDS: songbirds;habitat structure;habitat ordination;discriminant functional analysis;management implications;clearcutting;forest succession;Texas USA

ABSTRACT: *In 1975, 12 breeding bird species were spot-mapped in four pine stands of different heights and four comparable sized pine-hardwood stands. Vegetation at grid points within each species' territories was compared to vegetation not included in territories using a separate two-group discriminant function analysis (DFA) for each species. Correlations of original variables to the 12 DFA axes were calculated to determine which vegetation parameters were important to individual bird species. When compared to a single 12-group DFA, the two-group DFAs provided a more detailed description of individual species' vegetation requirements. Early succession bird species such as White-eyed Vireos, Yellow-breasted Chats, Prairie Warblers, and Northern Cardinals were positively associated with increasing density of shrub stems, foliage volume at 1 and 3 m high, percent sapling pines, and number of shrub species and negatively associated with increasing vegetation height, canopy closure, and number of pole-size trees. Late succession bird species such as Red-eyed Vireos, Black-and white Warblers and Tufted Titmice favored increasing vegetation height, number of tree species, and canopy closure. Other bird species had their own specific vegetation requirements.

131

Conner, R.N.; Dickson, J.G.;Williamson, J.H.

Potential woodpecker nest trees through artificial inoculation of heart rot.
Pp. 68-72 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: cavity-nest tree formation;artificial inoculation;heart rots;management implications;Texas USA

ABSTRACT: We suggest that the fungus Spongipellis pachyodon might be used to artificially create suitable hardwood nest trees for woodpeckers in both young and older trees and when supplies of potential nest trees are limited. Sizes of trees suitable for inoculation, inoculation heights, and densities of snags are suggested for six species of woodpeckers.

132

Conner, R.N.; Hooper, R.G.;Crawford, H.S.;Mosby, H.S.
Woodpecker nesting habitat in cut and uncut woodlands in Virginia.
J. Wild. Manage. 39:144-150 1975

KEYWORDS: woodpeckers;clearcuts;mature stands;nesting habitat;decay;management implications;Virginia USA

ABSTRACT: In forest areas common flickers nested only in dead snags in 1- to 12- year-old clearcuts. Pileated woodpeckers nested in mature, dense stands with high basal area, and downy woodpeckers nested in sparsely stocked stands with lower basal area. The hairy woodpecker nested in stands intermediate to and overlapping the habitats selected by the pileated and downy woodpeckers. All nest cavities of the four species of woodpeckers were excavated in decay wood of trees infected by fungal heart rots. Timber management may be detrimental to woodpeckers if all decayed trees are removed. Uncut filter strips along streams and roads appear to be of value as woodpecker nesting habitat.

133

Conner, R.N.; Kroll, J.C.;Kulhavg, D.L.
The potential of girdled and 2,4-D injected southern red oaks as woodpecker nesting and foraging sites.
South. J. Appl. For. 7:125-128 1983

KEYWORDS:

ABSTRACT: not reviewed

134

Conner, R.N.; Locke, B.A.
Effects of a prescribed burn on cavity trees of red-cockaded woodpeckers.
Wildl. Soc. Bull. 7:291-293 1979

KEYWORDS: fire: prescribed;cavity-tree damage;red-cockaded woodpecker;management implications;Texas USA

ABSTRACT: **The effects of a prescribed burn on cavity trees of red-cockaded woodpeckers are described. Trees with abundant resin were burned severely. Those trees with moderate resin flows and which combustible fuel had been raked to about 1 m from the tree received less damage than trees with more resin or 'unraked' trees. Burns on cavity trees can destroy the trees, cavities and cavity starts. It is suggested that a fire lane should be plowed around colony sites, and that colony sites should be burned separately with adequate raking and fire control equipment.

135

Conner, R.N.; Locke, B.A.
Fungi and red-cockaded woodpecker cavity trees.
Wilson Bulletin 94:64-70 1982

KEYWORDS: cavity trees;fungi infection;decay;Texas USA

ABSTRACT: *Recently killed Red-cockaded Woodpecker cavity trees were located during 1977-1980 in east Texas. Fungi from heartwood tissue at cavity sites and cavity starts was cultured on agar and identified. Heartwood decay was found in 63% of the cavity sites and 44% of the cavity-start sites examined. Longleaf pine cavity trees had a lower frequency of decay than did shortleaf and loblolly pine cavity trees. Phellinus pini was the most frequently detected fungus to be associated with red-cockaded cavity trees, but six other fungi species were detected. Our observations indicate that heartwood decaying fungi were not inoculated into the tree by the woodpeckers, but entered through broken branch stubs and were present prior to cavity excavation.

136

Conner, R.N.; Miller, O.K. Jr.;Adkisson, C.S.
Woodpecker dependence on trees infected by fungal heart rots.
Wilson Bull. 88:575-581 1976

KEYWORDS: fungal heart rot;tree cavities;Virginia USA

ABSTRACT: *Four species of woodpeckers used trees with heartwood softened by fungal heart rots prior to cavity excavation. The woodpeckers were apparently able to detect the presence of the heart rots and select suitably infected trees for nest excavations, thus reducing the energy expenditure necessary to excavate nest cavities. Spongipellis pachyodon was the primary rot in most of the trees we examined. Nest trees were usually infected secondarily by other Basidiomycetes, imperfect fungi, and bacteria.

137

Connor, R.N.; O'Halloran, K.A.
Cavity-tree selection by red-cockaded woodpeckers as related to growth dynamics of southern pines.
Wilson Bulletin. 99:398-412 1987

KEYWORDS: Cavity tree characteristics;discriminant analysis;management implications;shelterwood cutting;growth dynamics;pine forest;Texas USA

ABSTRACT: We compared measurements at 2122 Red-cockaded Woodpecker cavity trees and 150 randomly selected mature pines in eastern Texas. Discriminant analyses indicated that cavity trees were significantly older and taller, with greater crown depths, volumes, and weights, and larger diameters at breast height than were randomly selected mature pines. Examination of growth increment cores indicated that cavity trees had undergone a period of suppressed growth after which they were released by some type of natural or man-caused thinning. Because shelterwood cutting imitates the suppression and release phenomenon we observed, we suggest that this harvest technique be used instead of clearcutting in areas around woodpecker colonies in order to provide an immediate and sustained supply of potential cavity trees.

138

Conner, R.N.; Via, J.W.;Pather, I.D.
Effects of pine-oak clearcutting on winter and breeding birds in southwestern Virginia.
Wilson Bull. 91:301-316 1979

KEYWORDS: Breeding bird population;bird diversity;bird succession;clearcutting;forest succession;management implications;pine-oak;Virginia USA

ABSTRACT: *In pitch pine-oak stands in southwestern Virginia, winter species diversity and numbers of birds were lowest in the 3-year-old clearcuts and highest in the mature stands. Clearcutting reduced winter bird populations in all stages of pine-oak regeneration examined. There were no significant differences in bird species diversity among any of the study areas during the breeding season. The 3-year-old clearcuts had a higher number of birds during the breeding season than the other 3 differently aged areas. Species composition of breeding birds changed as the pine-oak stands regenerated toward maturity. When compared to the mature stands the net effect of pine-oak clearcutting on birds was negative.

139

Corns, I.G.W.; La Roi, G.H.
A comparison of mature with recently clear-cut and scarified lodgepole pine forests in the lower foothills of Alberta.
Can. J. For. Res. 6: 20-32. 1976

KEYWORDS: clearcutting;forest succession;site preparation;forest diversity;coniferous forest;Alberta

ABSTRACT: Mature, even-aged lodgepole pine forests on upland sites with Orthic Gray Luvisols in the Lower Foothills of Alberta have been clear-cut for pulpwood and scarified by bulldozer since 1958. Undisturbed stands had weak shrub strata, well developed herb - dwarf shrub strata, and continuous feather moss strata. In 25 clear-cut stands 6-12 years old, the average of vascular plants was 54% and did not change significantly during the sampled age interval. Cover of tree 'regeneration' (immature size classes) was 5, increasing slowly, and codominated by lodgepole pine and aspen. Shrub cover was also 5% and dominated by prickly rose. Herb - dwarf shrub cover was 44% and dominated by 9 species of the mature forest. Bryoid cover was 13%. The density of young trees stabilized within 6 years after clear-cutting, and above ground biomass of both pine and aspen increased rapidly during the sampled age interval. An ordination of the clear-cut stands showed that the distribution and abundance of several important plant species were well correlated with soil moisture on two gravimetric sampling dates in summer. A comparison of dominance-diversity curves and indices for mature and clear-cut stands revealed that the clear-cut community was richer in vascular species (100 cf. 57) and had a more even distribution of cover among species. The early stages of secondary succession after clear-cutting and scarification of lodgepole pine forest are discussed.

140

Cottam, G.; Curtis, J.T.
The use of distance measures in phytosociological sampling.
Ecology 37:451-460 1956

KEYWORDS: technique: habitat assessment;phytosociological sampling;closest individual method;nearest neighbor method;random pairs method;quarter method

ABSTRACT: *Four distance methods, including two point-to-plant and two plant-to-plant methods, were used on three mapped stands and artificial population. The data were compared with results obtained with the quadrat method, and with the known population parameters. It was found that all the distance methods were capable of yielding accurate results when an adequate sample was used, but that the size of an adequate sample varied with the method.

141

Coulmbe, R.; Lemay, A.B.
Evaluation of potential interactions between forest biomass production and Canadian wildlife.
Unpublished report prepared by Le Groupe Dryade for the Canadian Wildlife Service, Western and Northern Region, Edmonton. 262 pp + appendices. 1982

KEYWORDS: forest biomass production;wildlife;potential interactions;logging;rotation period;snag/residue removal;sensitive species;mitigation;management implications

ABSTRACT: This report presents an overview of existing knowledge of interactions between maximum forest biomass production and wildlife in Canada. This management concept implies the construction of more access roads to remaining untouched forests, the cutting of these mature and overmature stands (including the removal of all forest residues), intensive management of second-growth forests and techniques required to produce maximum volumes on short-rotation basis (biomass farming). Wildlife has been analyzed considering rare, threatened, endangered, recreational species and animals that are likely damaging trees. All the information contained in this report comes from available literature and unpublished information gathered in each province of Canada.

142

Crawford, H.S.; Hooper, R.G.;Titterington, R.W.
Songbird population response to silvicultural practices in central Appalachian hardwoods.
J. Wildl. Manage. 45:680-692 1981

KEYWORDS: avian ecology;songbird populations;bird succession;habitat disturbance;clear-cutting;single tree selection;thinning;silviculture;prescribed burn;group selection;hardwoods;Virginia USA

ABSTRACT: In central Appalachian hardwood stands songbirds were classified into groups of species that selected territories with similar habitat features. The degree of canopy closure of trees >7.3 m tall and the density of vegetation <1.8 m tall were the most important habitat features. Discriminant analysis was used to separate bird species into 5 groups based on habitat selection: (1) closed-canopy-obligatory species, (2) species skewed toward closed canopy, (3) centrally distributed species, (4) species skewed toward open canopy, and (5) obligatory open-canopy species. Changes in groups can be predicted by the change in configuration of overstory and understory vegetation. Bird succession following cutting generally follows sequentially from open-obligatory to closed-canopy-obligatory species; however, the initial stage depends upon the degree to which the stand was opened.

143

Crawford, H.S.; Jennings, D.T.
Effects of birds on spruce budworm populations - a progress report.
Pp. 315-321 in: J.A. Bissonette, ed. Is good forestry good wildlife management? Proc. of a Joint Conference, March 6-8, 1985, Portland, Maine. 1986

KEYWORDS: spruce budworm;bird-insect relationships;bird-habitat relationships;forest management;group selection;shelterbelt harvesting;economics;management implications

ABSTRACT: The spruce budworm is a serious pest of spruce-fir forests in the United States and Canada. Enhancing its natural enemies is desirable for integrated pest management. Forest birds are effective predators; they consume substantial numbers of spruce budworm larvae and pupae. With proper habitat management, bird populations can be increased. For example, stand diversity can be increased by group selection or by shelterwood harvesting methods. This will increase populations of effective bird predators and enhance their role in integrated pest management.

144

Crawford, H.S.; Titterington, R.W.
Effects of silviculture practices on bird communities in upland spruce-fir stands.
Pp. 110-119 in: R.M. DeGraaf and K.E. Evans, tech. coord. Management of north central and northeastern forests for nongame birds. Workshop Proc., Jan 23-25, 1979, Minneapolis, Minnesota. USDA For. Serv. Gen. Tech. Rept. NC-51. 1979

KEYWORDS: avian ecology;avian density;avian diversity;forest structure;bird-habitat relationships;bird-insect relationships;silviculture;even aged management;uneven-aged management;clear cutting;site preparation;planting;thinning;management implications;spruce-fir forests;North America

ABSTRACT: Composition and density of bird populations in upland spruce-fir stands are influenced by the admixture of hardwood with softwoods, the vertical and horizontal structure of the stand, and the extent of spruce budworm infestation of the stand. Silviculture practices modify all three factors and influence bird populations.

145

Crawford, H.S.; Titterington, R.W.;Jennings, D.T.
Bird population and spruce budworm populations.
J. Forest. 81: 433-435. 1983

KEYWORDS: spruce budworm;spruce budworm outbreaks;breeding birds;foraging behaviour;passerines;coniferous forest;New England USA

ABSTRACT: In northern New England, numbers of birds and amounts of budworm larvae and pupae eaten per bird increased as insect populations increased. Birds ate approximately 2, 23 and 87% of the epidemic, transitional and endemic populations. Blackburnian and Nashville warblers, golden-crowned kinglets, white throated sparrows, and black capped chickadees were important predators in stands with endemic budworm populations. Bird communities most effective as budworm predators are found in mature managed forests containing a mix of species and size classes with scattered openings and patches of regeneration.

146

Crockett, A.B.; Hanoley, P.L.
Apparent response of Picoides woodpeckers to outbreaks of the pine bark beetle.
Western Birds 9:67-70 1978

KEYWORDS: woodpeckers;bird-insect relationships;bark beetle outbreaks;woodpecker response;Colorado USA

ABSTRACT: **The comparison of information on woodpecker beetle relationships show a number of similarities: 1) northern three-toed woodpeckers, hairy woodpeckers and downy woodpeckers (in decreasing order of abundance) respond to bark beetle epidemics. 2)increases in woodpecker populations were most significant in the nonbreeding season, immediate responses resulting from immigration or aggregation, 3) adult and larvae bark beetles formed 67-99% of the winter diet of the three woodpeckers in infected areas, 4) woodpecker activity, directly and indirectly, resulted in 45-98% decrease in beetle survival, 5) the intensity and duration of woodpecker response may be increased by secondary borers.

147

Cross, C.W.;
Wildlife use of small forest clearings in the Adirondacks.
M.Sc. State University College of Forestry at Syracuse University. 1963

KEYWORDS: clearings;wildlife use;songbirds;post-clearing response;habitat selection;New York

ABSTRACT: *This thesis documents seasonal wildlife usage of 15 clearings located in the mature forests of the Adirondack Region of Northeastern New York. These 0.4 to 0.5 acre clearings were one to four years old when studied; most of them were situated on northern hardwood sites. A vegetative survey revealed that clearings in the Region could be classified on the basis of existing ground cover. Recently created clearings had large amounts of slash, bare ground and grass, which were replaced in older clearings by raspberry. It was suggested that pearly everlasting would be the next species to dominate these sites. More birds were observed at the juncture between clearings and surrounding forest types than in the interior of these types. Woodpeckers, red-eyed vireos, phoebes and wood peewees exhibited an attraction to clearings. A similar trend was suggested for white-throated sparrows, chestnut-sided warblers, blackburnian warblers and yellow-throats. Ovenbirds, black-throated green warblers and winter wrens showed a strong preference for northern hardwood forests. Scarlet tanagers, olive-backed thrushes and black-throated blue warblers were less abundant in the hardwood-conifer type; redstarts favored this type .

148

Crouch, G.L.;
Effects of commercial clearcutting of aspen on understory vegetation and wildlife habitat values in southwestern Colorado.
1983

KEYWORDS: aspen;clearcutting;understory vegetation;forest succession;habitat;birds/wildlife;management implications;economics;Colorado USA

ABSTRACT: Aspen is clearcut in the central Rocky Mountains to obtain wood products, to enhance its value as wildlife habitat, and to ensure its perpetuation for scenic beauty. Clearcutting is especially important since much of the aspen is mature, and fire, its natural regenerative force, has been successfully suppressed in recent years. Commercial clearcutting is probably the most economical method to renew aspen but usually requires logging relatively large acreages to recover operating costs. Except for overstory loss, clearcutting and removal of logs in more than 60 nearby blocks of mature aspen ranging in size from 2 to 20 acres resulted in few lasting changes in understory plant characteristics during 5 years after logging. Overstory removal adversely affected cavity-nesters and other species requiring mature forest, but clearing for roads and harvesting should benefit species needing sparsely vegetated areas and forest edges, and those favoring tall, dense, shrub-like habitats provided by aspen sprouts in older clearcuts. In future sales, wildlife benefits can be enhanced by extending timber sales in local areas over 10 years or more or by making several sales periodically. These options would reduce the acreage of overstory removed at one time and also prolong benefits to species favoring forest openings.

149

Cunningham, J.B.; Balda, R.P.;Gaud, W.S.
Selection and use of snags by secondary cavity-nesting birds of the ponderosa pine forest.
USDA For. Serv., Rocky Mount. For. and Range Exp. Stat., Res. Pap. RM-222. 15 pp. 1980

KEYWORDS: avian ecology;cavity-nesting birds:secondary;snags;snag characteristics;cavity-tree characteristics;management implications;ponderosa pine;Arizona USA

ABSTRACT: The results of this investigation indicate that snags are important as nest and roost sites; provide a large number of bird species with hawking, singing and drumming, or perching posts; and provide a feeding substrate for many species. The following guide to the characteristics of desirable snags is proposed: (1) diameter of snags should be greater than 33 cm; (2) total height of snags should be greater than 6 m; (3) percent bark cover should be greater than 40%; (4) ponderosa pine snags in the most frequently used age range of 5-29 years should be saved; (6) in areas where the available snags are below the size range stated above, the largest snags should be saved; (7) snags with existing cavities should be given preference; (8) oaks >26 cm dia should be saved; (9) secondary nesters utilize the dead strips from lightning strikes. Since such trees are usually poor quality timber trees, they should be saved for immediate use by the birds and as a means of producing future snags, (10) hard snags should be removed in preference to soft snags; (11) trees with dead tops should be left for nest and roost sites and for future snag replacement; (12) in mature ponderosa pine forest, snag density should be 5.2 snags per ha.

150

Currie, F.A.; Bamford, R.
The value to birdlife of retaining small conifer stands beyond normal felling age within forests.
Q. J. For. 76: 153-160. 1982

KEYWORDS: breeding birds;avian density;avian diversity;cavity-nesting birds;forest diversity;management implications;coniferous forest;Wales

ABSTRACT: Both breeding bird density and diversity found in small stands of 100-year-old Douglas-fir, European larch and Norway spruce was about double that found in 26- to 53-year-old stands in north Wales. Canopy depth, shrub layer and dead, decaying trees were features identified of importance and occurred largely in the old conifer habitat. Several species more associated with semi-natural woodland were found breeding. These included spotted flycatcher and wood warbler with pied flycatcher, redstart and starling making use of great woodpecker excavations. Some guidelines are suggested for foresters considering retention of conifer stands beyond normal felling age.

151

Curtis, R.L.; Ripley, T.H.
Water management practices and their effect on nongame bird habitat values in a deciduous forest community.
Pp. 128-141 in: D.R. Smith, tech. coord. Proc. of the symposium on management of forest and range habitats for

nongame birds. USDA For. Serv. Gen. Tech. Rept. WO-1. 1975

KEYWORDS: forest management;water management;bird-habitat relationships;habitat alteration;clear cutting;selection cutting;understory removal;vegetation conversion;herbicides;management of implications

ABSTRACT: In the future, demands on water resources will play a much larger role in the management of eastern forests. The technique utilized to manage forest lands for increased water yield and quality will modify existing forest ecosystems. Consequences of these modifications on nongame birds is largely unknown. A synthesis of available information concerning the effects of water management practices on nongame birds is presented.

152

Davis, J.W.; Goodwin, G.A.;Ockenfels, R.A., tech. coord.
Snag habitat management: proceedings of the symposium.
USDA For. Serv., Gen. Tech. Rep. RM-99. 226 p. 1983

KEYWORDS: snag habitat;snag management;cavity-nesting birds;forest management;snag formation

ABSTRACT: *Only recently have resource managers recognized the importance of snag habitat and the problems associated with its management. The majority of cavity-nesting birds are insectivorous, and play an important role in the control of forest insect-pests. The concept of this symposium therefore, was to recognize the problem, exchange ideas and solutions, and disperse information among land managers, industry, researchers, resource specialists and wildlife biologists. The data and ideas presented here are urgently needed to integrate snag habitat management with other equally valid resource uses and demands.

153

Davis, P.R.;
Response of vertebrate fauna to forest fire and clearcutting in south-central Wyoming Final report, Co-op Study 16-391-CA and 16-46A-CA USDA For. Serv. and Univ. Wyo., Laramie. 94 p.
1976

KEYWORDS:

ABSTRACT: not reviewed

154

Dawson, D.G.;
Counting birds for a relative measure (index) of density.
Pp. 12-16 in: Ralph, C.J. and J.M. Scott, eds. Estimating numbers of terrestrial birds. Stud. Avian Biol. 6.
1981

KEYWORDS:

ABSTRACT:

155

Dawson, D.K.;
Bird communities associated with succession and management of lowland conifer forests.
Pp. 120-130 in: R.M. DeGraaf and K.E. Evans, tech. coord. Management of north central and northeastern forests for nongame birds. Workshop Proc., Jan 23-25, 1979, Minneapolis, Minnesota. USDA For. Serv. Gen. Tech. Rept. NC-51. 1979

KEYWORDS: avian ecology;avian communities;avian diversity;avian density;avian succession;forest succession;bird-habitat relationships;timber management;clear cutting;site preparation;rotation age;herbicides;silviculture;management implications;conifer: lowland forests;North America

ABSTRACT: Data from published bird censuses were used to determine changes in avian communities in relation to plant succession, fire, type conversion, and timber management practices in lowland conifer forests in the northeastern United States. With modifications in current logging practices, habitat for the bird species that nest in undisturbed stands can be provided. Management guidelines are recommended.

156

DeByle, N.V.;
Songbird populations and clearcut harvesting of aspen in northern Utah.
USDA For. Serv., Int. For. and Range Exp. Stat., Research Note INT-302. 7 pp. 1981

KEYWORDS: avian ecology;songbirds;breeding populations;avian diversity;clearcutting;aspen;management implications;Utah USA

ABSTRACT: Songbird populations on 10 acres of aspen forest were censused during early summer for 2 years prior and for 2 years after clearcutting more than half of the census area. Numbers of breeding pairs, by species, were estimated. Some 33 bird species were seen each year, with 12 to 19 of them nesting. Temporary change in habitat was implicated in the decline or loss of five species and the increase or invasion of three others.

157

DeGraaf, R.M., tech. ed.;
Proceedings of the workshop on management of southern forests for nongame birds.
USDA For. Serv., Gen. Tech. Rept. SE-14. 176 p. 1978

KEYWORDS: nongame birds;management techniques;habitat research

ABSTRACT: *The National Nongame Bird Steering Committee was formed to sponsor regional workshops to present the state of the art of nongame bird research and management in various ecoregions of the United States. The workshop presented in this symposium is the second in the series, and presents bird habitat research results and management techniques for all major habitat types in the southern and southeastern United States.

158

DeGraaf, R.M.;
The importance of birds in ecosystems.
Pp. 5-11 in: R.M. DeGraaf, tech. coord. Proceedings of the workshop on nongame bird habitat management in the coniferous forests of the western United States. USDA For. Serv. Gen. Tech. Rept. PNW-64. 1978

KEYWORDS: forest ecosystems;birds: importance of;foraging behaviour;bird-insect relationships;nutrient cycling;recreational importance

ABSTRACT: Birds are important in forest ecosystems through their roles in energy transfer through food webs and nutrient cycling; and birds are an important recreational resource. The consumption of foliage insects probably constitutes the major functional role of birds in forests. While birds apparently cannot control insect outbreaks, the main role of birds appears to be one of acting to prevent insect outbreaks, or of dampening insect population oscillations. Birds exert the greatest influence on insect populations at endemic levels, and may thus also serve to increase the time interval between insect outbreaks. While birds account for relatively minor parts of the standing nutrient pools of forest ecosystems, bird migration has been shown to account for 16% of the net phosphorous loss from a forest ecosystem. Recreational values of birds cannot be ignored--there are millions of birdwatchers in the U.S., and dollar expenditures to enjoy birds exceeds $500 million annually.

159

DeGraaf, R.M., and Tilgham, N., eds.
Workshop proceedings: management of western forests and grasslands for nongame birds.
USDA For. Serv., Gen. Tech. Rep. INT-86. 535 p. 1980

KEYWORDS: nongame birds;bird-habitat relationships;habitat management;forest management

ABSTRACT: **This is the fourth and last workshop on the management of nongame birds and their habitat. It presented information on bird habitat management and specialized habitat needs for western forest and grassland regions.

160

DeGraaf, R.M.; Evans, K.E., eds.
Proceedings of the workshop on management of northcentral and northeastern forest for nongame birds.
USDA For. Serv., Gen. Tech. Rep. NC-51. 268 p. 1979

KEYWORDS: nongame birds;habitat;habitat management;bird-habitat relationships

ABSTRACT: *This is the symposium of the third workshop on the management of nongame birds, covering the northcentral and northeastern ecoregions of the United States. As with the other workshops, bird habitat research results and management techniques for all major habitats types are presented.

161

DeGraaf, R.M.; Chadwick, N.L.
Forest type, timber size class, and New England breeding birds.
J. Wildl. Manage. 51:212-217 1987

KEYWORDS: avian ecology;avian diversity;breeding birds;habitat selection;forest structure/composition;management implications;New Hampshire USA;Maine USA

ABSTRACT: Breeding birds in pole and mature sawtimber stands of 6 forest cover types were grouped by association with timber size class, forest cover type, interactions of timber size and type, and the habitat components that occur irrespective of stand condition or forest type. Thirty bird species showed different distributions by forest cover type, 3 species' distributions differed by timber size class, and 13 species' distributions were functions of the interaction of cover type and size class. Breeding birds were grouped as stand condition obligates, forest type obligates, or species that prefer >1 forest type regardless of stand condition, prefer 1 stand condition, select a specific stand condition-forest type interaction, or are habitat generalists. The results are useful when planning the mix of types or distribution of timber size classes in the Northeast.

162

DeGraaf, R.M.; Shingo, A.L.
Managing cavity trees for wildlife in the northeast.
USDA For. Serv., Northeast. For. Exp. Stat., Gen. Tech. Rep. NE-101. 21 pp. 1985

KEYWORDS: avian ecology;cavity-nesting birds;habitat selection;cavity-tree characteristics;management implications;Massachusetts USA

ABSTRACT: **A paper which describes the function of dead trees and trees that contain decaying wood in the forest ecosystem. Information on preferred habitat and habitat use by cavity-nesting birds, and the number of cavity trees required to sustain maximum populations is given.

163

DeGraaf, R.M; Wentworth, J.M.
Urban bird communities and habitats in New England.
Unpublished manuscript, USDA For. Serv., Northeas. For. Exp. Stat. N.D.

KEYWORDS: avian ecology;avian diversity;avian density;breeding birds populations;habitat preference;foraging behaviour;habitat structure;management implications;Massachusetts USA

ABSTRACT: This paper describes a two-year study of the bird communities in urban and suburban areas. Bird densities were higher in the urban areas, though bird diversity was higher in the suburbs. Differences in foraging strategies were reflected in the habitat selections of the birds. Over a five-year period, the suburban avifaunas showed changes in community structure.

165

DellaSala, D.A.;
Response of three songbird species to forest disturbances in large tracts of northern hardwoods.
Ph.D. Diss., Univ Michigan. 87 p. 1986

KEYWORDS: forest disturbance;timber harvest;forest fragmentation;avian ecology;avian diversity;avian density;hardwood forests;management implications;Michigan USA

ABSTRACT: Prior studies of forest disturbances have examined the influence of size of a forest fragment on species diversity. Frequently, this information has been used in recommendations for forest preserves. This study examined the effects of size and shape of forest disturbances on the densities and spatial distributions of three songbird species in large tracts (>100 ha) of northern hardwood forests in Michigan. Species studied included the red-eyed vireo, ovenbird, and least flycatcher. Distributions of red-eyed vireos and ovenbirds were studied in relation to openings of different shapes and sizes, while least flycatchers were studied only in relation to opening size. For red-eyed vireos and ovenbirds, study sites were primarily square shapes, and included small (0.02 ha), medium (0.8 ha), and large (>5 ha) openings. In addition, a petroleum pipeline-corridor represented a narrow-rectangular (15 m wide) opening. Opening sites were compared to undisturbed plots located at least 400 m from a forest opening. For least flycatchers, spatial distribution was studied in relation to openings from 0.8 to 22 ha. Results for red-eyed vireos and least flycatchers indicate that the effects of forest disturbances in large continuous forests are related to opening size. Declines in red-eyed vireos were more severe for large openings than medium ones, and were detected over greater distances into the forest interior. Average reductions in densities of 22 to 50 % were detected over distances of 250 and 400 m for medium and large openings; respectively. However, these estimates were based on considerable variation in vireo density with distance from a forest opening. No avoidance was observed for small or narrow-rectangular openings. Declines in breeding density of ovenbirds were not observed. Shifts in spatial distributions of least flycatchers were also related to forest opening size. This species forms dense aggregations that were displaced farther into the forest interior as size of openings increased. Response was detected over average distances of up to 200 m from a disturbance for opening >= 10 ha. Results of this study suggest that recommendations for forest reserves that are derived solely form the response of species to size of forest fragments, may underestimate the amount of interior habitat needed by some songbirds. Data on flycatcher and vireo distributions suggest that "buffer zones" equivalent to the distances over which these birds were displaced by an opening are also needed in estimates of reserve size.

166

DeLotelle, R.S.; Epting, R.J.
Selection of old trees for cavity excavation by red-cockaded woodpeckers.
Wildl. Soc. Bull. 16:48-52 1988

KEYWORDS: red-cockaded woodpecker;tree preference;cavity-tree characteristics;Florida USA

ABSTRACT: Red-cockaded woodpeckers selected cavity trees ranging from 54 to 158 years in age. Cavity trees were significantly older than stand trees within territories. Patterns of tree selection were different, however, for each area studied. A threshold age level of about 60 years is suggested for the use of longleaf pine for cavity trees.

167

Des Granges, J.L.;
Avian community structure of six forest stands in La Maurice National Park, Quebec.
Can. Wildl. Serv., Occas. Paper No. 41. 34 pp. 1980

KEYWORDS: forest structure;forest succession;bird-habitat relationships;avian succession;avian diversity;Shannon-Weiner Index;spatial distribution;foraging niches;Quebec

ABSTRACT: A qualitative and quantitative study of bird communities was made on forest stands of six different types. Censuses were made by the spot-mapping technique. The precision of the results was tested by drawing a cumulative variety curve and by applying the performance test to the results compiled in each of the six quadrates. The influence of species composition of the vegetation on avifauna within a given habitat is only indirect. The species composition affects the physiognomy of the vegetation which, in turn, influences the composition of the avian community. In the initial stands, which are open, most of the avifauna is found at ground level and in the shrubs, whereas in the denser growth of the older stands the majority is found in the canopy. The distribution of birds, therefore, follows the development of plant strata and the abundance of birds depends on the physiognomy of the forest, that is, on the number of growth-forms and the distribution of trees. The number of permanent resident species (mostly omnivorous) tends to increase during succession. This is probably attributable to the greater permanence of the climax forest, and its wider and more regular distribution which has permitted species to adapt their feeding habits to exploit a seasonally changing food supply, thus permitting them to remain resident throughout the year. The diversity of an avian community, as calculated by the Shannon-Wiener formula, is influenced more by species variety than by equitability of abundance. Equitability (and indirectly diversity) of avian communities seems to depend mostly on the physiognomic diversity of the plant community. Thus, the more complex the physiognomy is, the greater the equitability value of the avian community tends to be.

168

DeWeese, L.R.; Henny, C.J.;Floyd, R.L.;Bobal. K.A.;Schultz, A.W.
Responses of breeding birds to aerial sprays of trichlorfon (dylox) and carbaryl (sevin-4-oil) in mountain forests.
US Dept. Int., Fish and wildlife Serv. Special Sci. Report - Wildlife No. 224. Washington, D.C. 25 pp. 1979

KEYWORDS: insecticides: effects of;trichlorfon;carbaryl;post-spraying response;avian mortality;avian density;nesting success;food;management implications;Montana USA

ABSTRACT: Breeding density, food nesting success, and mortality of 20 bird species were monitored at Beaverhead National Forest, Montana, in 1975 in conjunction with experimental applications of trichlorfon and carbaryl to western budworms. Bird species on nine 350- to 550-ha forested plots (3 controls and 3 treated with each pesticide) were studied before and for 14 days after the spraying of trichlorfon at 1.1 kg in 9.4 L of Panasol AN3 per ha (1 pound active ingredient in 1.0 gallon per acre) and of carbaryl at 1.1 kg in 4.7 L of diesel oil per ha (1 pound active ingredient in 0.5 gallon/acre). No significant decrease in bird numbers was detected from breeding-pair estimates or live bird counts after the spraying. Of the breeding pairs present before spraying, 92% remained on control plots, 89% on trichlorfon plots, and 92% on carbaryl plots. Counts of live birds made before and after spraying in three types of habitat supported the results of the breeding pair estimates. Nests with eggs or with young at the time of spraying were 74 and 97% successful, respectively, in control plots, 83 and 100% in plots sprayed with trichlorfon, and 86% and 100 in plots sprayed with carbaryl. No sick or dead birds were found after the spraying, although budworms were found in bird stomachs, and tracer-dye from the pesticides occurred on the feathers or feet of 74% of the 202 birds collected. Species dwelling in the tree canopy encountered the dye (and thus the pesticide) at a slightly higher rate (80%) than did species below the treetops (71%) or near the ground and in open areas (70%).

169

DeWeese, L.R.; Pillmore, R.E.;Richmond, M.L.
A device for inspecting nest-cavities.
Bird Banding 1975

KEYWORDS: technique;nest-cavity inspection

ABSTRACT: A device which can be used to inspect nest cavities is described in this paper. Construction instructions and estimated costs are provided.

170

Diamond, A.W.;
An evaluation of the vulnerability of Canadian migratory birds to changes in neotropical forest habitats.
A report to the Latin American Programme of the Canadian Wildlife Service, Conservation and Protection, Environment Canada. 93 pp. 1986

KEYWORDS: migratory birds;breeding habitats;wintering habitats;distribution;habitat selection;population trends;deforestation;Canada;Central America

ABSTRACT: *More than half of the species of bird which breed in Canadian forests and migrate to Latin America for the winter are likely to lose more than 25% of their wintering habitats by the year 2000, and 12 of these are expected to lose half or more. The most vulnerable species winter mainly in the isthmus of Central America, many of them chiefly in broadleaved forest. Species inhabiting more open types of woody vegetation seem to be less immediately vulnerable, but the available figures for the area of these vegetation types are serious over-estimates, and predicted increases in these kinds of vegetation - at the expense of mature broadleaved forest - are likely to be exaggerated. Any real increases in second-growth forest will be short-lived as human pressure on the land increases. There is no convincing evidence that species vulnerable to tropical deforestation are yet declining on their breeding ground in Canada. Nor is there any convincing evidence that they are not. Data sources which may potentially show trends need to be investigated. The interpretation of the effects on breeding populations of the predicted changes in habitat is hampered by lack of the necessary data on ecology and behaviour of the species in their winter quarters. However, quantitative studies of populations trends and habitat preference are also required for the breeding grounds and migration routes. The lack of remote-sensing capability to measure areas of habitat in the most vulnerable area, the Central America isthmus, is a serious obstacle to monitoring changes.

171

Dickson, J.G.;
Forest bird communities of the bottomland hardwoods.
Pp. 66-73 in: R.M. DeGraaf, tech. coord. Proc. of the Workshop: management of southern forests for nongame birds. Jan 24-26, 1978, Atlanta, Georgia. 1978

KEYWORDS: avian ecology;breeding bird populations;bird-habitat relationships;bottomland hardwoods;forest management;management implications;USA

ABSTRACT: Bottomland hardwoods, which are dwindling in area, support abundant breeding and winter birds. To help birds associated with bottomland hardwoods, land managers should: keep land in forests, maintain diversity of trees species and stand ages, maintain some old stands, maximize stand vertical foliage layers and habitat patchiness, and take special measures for rare bird species.

172

Dickson, J.G.; Conner, R.N.;Fleet, R.R.;Kroll, J.C.;Jackson, J.A., eds.
The role of insectivorous birds in forest ecosystems.
Academic Press, New York. 381 p. 1979

KEYWORDS: insectivorous birds;bird-insect relationships;foraging behaviour;habitat utilization;forest ecosystems

ABSTRACT: *This volume includes an introduction to and history of insectivorous birds and their roles in forest ecosystems, discussions of sampling methods for bird and insect populations, bird foraging strategies, ecology of insectivorous bird species and communities, and an overall discussion and conclusion.

173

Dickson, J.G.; Conner, R.N.;Williamson, J.H.

Snag retention increases bird use of a clear-cut.
J. Wildl. Manage. 47: 799-804. 1983

KEYWORDS: clearcut;snag retention;post-logging response;avian diversity;avian density;cavity-nesting birds;management implications

ABSTRACT: Birds were counted during the breeding season from 1977 to 1981 in 4 snag and snagless plots (80 by 250 m) in an east Texas clear-cut to assess effects of snag retention on the bird community. After 4 years, 44 of the original 75 snags remained. Species richness, bird abundance, bird species diversity, and equitability were all higher ($P<0.05$) in plots with snags than in snagless plots. Cavity-nesting birds occurred on plots with snags but were virtually absent from snagless plots. Other species used snags for foraging and perching and were more abundant on plots with snags. Retention or creation of snags is recommended for bird management in clear-cuts.

174

Dickson, J.G.; Segelquist, C.A.
Breeding bird populations in pine and pine-hardwood forests in Texas.
J. Wildl. Manage. 43:549-555 1979.

KEYWORDS: avian ecology;avian diversity;avian density;forest structure;forest succession;forest management;management implications;Texas USA

ABSTRACT: *The objectives of this study were to census breeding bird populations in pine and pine-hardwood stands of different heights in east Texas and to evaluate the effects of stand height and composition on bird populations. Our results indicate that on sites similar to those we studied, high breeding bird density and diversity may be maintained by managing for a maximum of vertical layers of diverse vegetation, especially layers near the ground. Pine stands with little herbaceous or hardwood vegetation have little vertical layering and few breeding birds. Silvicultural practices which increase layers of vegetation will likely increase breeding bird density and diversity.

175

Dickson, J.G.; Segelquist, C.A.;Williamson, J.H.
Relative abundance of breeding birds in forest stands in the Southeast.
South. J. Appl. For. 4:174-179 1980

KEYWORDS:

ABSTRACT: not reviewed

176

Diem, K.L.; Zeveloff, S.I.
Ponderosa pine bird communities.
Pp. 170-197 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: forest structure;avian ecology;avian diversity;foraging behaviour;silviculture;snag management;timber: non-commercial;ponderosa pine;management implications

ABSTRACT: Ponderosa pine forests with respect to the community's extensive distribution and its development under a wide range of environmental conditions. Bird species composition and distribution are discussed with respect to the vegetative structure in a community with uneven-aged aggregation of even-age tree groups. Bird species sensitive to environmental change are identified. Plight of the non-commercial forest avian resources is described. Integrated resource management of nongame birds is discussed.

177

Dingledine, J.V.; Haufler, J.B.
The effect of firewood removal on breeding bird populations in a northern oak forest.
Pp. 45-50 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: avian ecology;breeding bird populations;avian density;avian diversity;snags;firewood removal;management implications;oak forest;Michigan USA

ABSTRACT: Breeding bird populations and snags were examined in relation to a controlled firewood removal in a northern oak forest in Michigan. Snag densities were significantly decreased by the firewood removal, but a complete reduction did not occur due to new snag generation and the presence of certain snags unsuitable as firewood. Cavity-nesting bird species were not decreased by the firewood removal due in part to the utilization of live trees or dead portions of live trees as nest sites. Snags did provide important foraging sites, but their loss did not cause identifiable decreases in the use of the study areas in this investigation.

178

Dowden, P.B.; Joynes, H.A.;Carolin, V.M.
The role of birds in spruce budworm outbreak in Maine.
J. Econ. Entomol. 46:307-312 1953

KEYWORDS: spruce budworm outbreak;bird-insect relationships;intake estimates;Maine USA

ABSTRACT: *In 1949 and 1950 a cooperative study between the Federal Bureau of Entomology and Plant Quarantine and the Fish and Wildlife Service was undertaken in an attempt to measure the effect of feeding by insectivorous birds on the spruce budworm infestation in northern Maine. Field work was carried out on three study areas. On two of them birds were undisturbed. On the other an attempt was made to shoot all the birds found during the period they normally feed heavily upon budworms. Estimates of budworm populations were made on all three areas before shooting and directly afterwards. While it was impossible to obtain a reliable quantitative measure of the effect of birds by the methods used, indications are that birds consumed between 100 and 300 budworms per tree on one of the check areas in 1949 and 1950. Information obtained regarding the number and species of birds and the food they consumed on the collection area has been published separately.

179

Dunlavy, J.C.;
Studies on the phyto-vertical distribution of birds.
Auk 52: 425-431 1935

KEYWORDS: avian ecology;phyto-vertical distribution;bird-habitat relationships;nesting site;refuge site

ABSTRACT: Phyto-vertical distribution is a term used to designate the vertical distribution of birds in the local vegetation. In our studies in the chaparral, it was found necessary to delimit clear-cut zones based on the vegetational levels, and to establish criteria by which the birds could be assigned to their respective zones. The criterion used in our observations was the height of the place chosen by a bird for refuge in time of danger. We compare this to the altitude of the nesting site (our second criterion). There is a remarkable degree of agreement between the zones chosen for nesting and the zones chosen for refuge by the different species of birds. We believe that this agreement gives us a clue to the true habitat zone of any particular species, and a basis for a phyto-vertical distribution of birds.

180

Edgerton, P.J.; Thomas, J.W.
Silvicultural options and habitat values in coniferous forests.
Pp. 56-65 in: R.M. DeGraaf, tech. coord. Proceedings of the workshop on nongame bird habitat management in the coniferous forests of the western United States. USDA For. Serv. Gen. Tech. Rept. PNW-64. 1978

KEYWORDS: avian ecology;avian diversity;bird-habitat relationships;timber management;silviculture;rotation period;single tree selection;group tree selection;even-aged management;management implications

ABSTRACT: The welfare of all birds must be accounted for in forest management decisions. Different bird species select different forest types and successional stages for feeding and reproduction. Birds are grouped into life forms according to habitat requirements. Using this framework, a system for evaluating bird response to habitat alteration due to silvicultural systems and associated practices is presented.

181

Edwards, M.G.;
Raptor management.
Pp. 129-134 in: R.M. DeGraaf, tech. coord. Proc. of the Workshop: management of southern forests for nongame birds. Jan 24-26, 1978, Atlanta, Georgia. 1978

KEYWORDS: raptor management;timber management;land use impacts;management implications;USA

ABSTRACT: Interest in raptors and their preservation has resulted in state and federal laws protecting them from trapping, shooting and poisoning. While many of man's activities are destructive, some can be modified to lessen their impact on raptors.

182

Edwards, W.R.; Ellis, J.A.
Responses of three avian species to burning.
Wilson Bull 81:338-339 1969

KEYWORDS: fire;avian response

ABSTRACT: Bobwhites, Mourning Doves, and an American Woodcock were observed to respond positively to burning of the vegetation on a 2 acre field. Vegetation on the field at the time of burning was an admixture of grasses and weedy forbs.

183

Egeline, S.;
Wildlife relationships and forest planning.
Pp. 379-389 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: habitat;wildlife;land use planning;ecosystem;old growth;diversity;management implications

ABSTRACT: The issue in wildlife resources planning is not which habitat are to be retained or even which are most important. The primary issue is what distribution of relative abundances among all the habitats will provide the most desirable mix of wildlife within the demands for individual species and within ecological considerations for wildlife diversity. The WHR program has begun to enable land managers and biologists to evaluate effects in a manner meaningful to address the issues and concerns. The question of old-growth habitat, what it is and how it might be desirable is discussed as an example of WHR application in forest planning. Evidence from past descriptions ecological theory and species adaptation patterns obtained from WHR data indicate that old-growth consists of distinct habitats and the relative abundances of these habitats are currently much different than those existing prior to the influence of modern man.

184

Eidt, D.C.; Pearce, P.A.
The biological consequences of lingering fenitrothion residues in conifer foliage - a synthesis.
For. Chron. 246-249 1986

KEYWORDS: insecticide;fenitrothion;spruce budworm control;non-target species

ABSTRACT: Conifer foliage is a sink for fenitrothion, with a limited capacity for accumulation. Fenitrothion, not derivatives or metabolites, is retained from year to year in foliage on the tree and for at least one year in foliage in forest litter. Translocation can occur but has not been demonstrated to new foliage from foliage treated the previous year. Among forest animals, only insects have been identified as confined entirely to a diet of conifer needles. Vertebrates that feed extensively on conifer foliage are deer, moose, snowshoe hares, and spruce grouse; spruce grouse is probably the most sensitive to fenitrothion. It is concluded that fenitrothion in coniferous foliage presents no unacceptable hazard to those forest animals deemed most at risk.

185

Emlen, J.T.;
Habitat selection by birds following a forest fire.
Ecology 51:343-345. 1970

KEYWORDS: habitat disturbance;forest fire;post-fire responses;avian ecology;bird populations;habitat selection;pine:slash;Florida USA

ABSTRACT: *In the light of current opinion that habitat selection by birds is determined by gross visual aspects from the vegetation physiognomy, one might intuitively expect that drastic alteration of the ground and shrub strata of a forest would modify the composition and numerical status of resident bird populations. However, counts in a burned pine stand in southern Florida during the first few months after burning were essentially no different than counts in an immediately adjacent unburned stand. The lack of response to this habitat alteration may be attributed behaviorally to individual home range attachments by the resident birds. Its occurrence in this situation may be associated with the relatively brief duration of these severe habitat disruptions and the frequency of forest fires as a normal feature of slash pine ecology.

186

Emlen, J.T.;
Population densities of birds derived from transect counts.
Auk 88:323-342 1971

KEYWORDS: techniques:census;transect counts;avian density;management implications

ABSTRACT: *Census methods for nonflocking land birds are reviewed and a new method is described that is applicable at all seasons, is more efficient than the intensive plot methods, and is apparently comparable in accuracy. In the new method foot transect counts are made in which all detections, visual and aural, out to the limit of detectability are tallied. The count for each species is then multiplied by a conversion factor (coefficient of detectability) representing the per cent of the population that is normally detected by these procedures. Conversion values are derived directly from distributive curves of detection points laterally from the observer's trail. Conversion values are finally adjusted for incompleteness in the strip of optimum coverage close to the transect trail. Field procedures used in testing the new method are described and samples of preliminary results are presented and evaluated.

187

Emlen, J.T., Jr.;
A method for describing and comparing avian habitat.
Ibis 98:555-576 1956

KEYWORDS: technique;avian habitat;habitat assessment;habitat comparisons

ABSTRACT: *Detailed studies of ecological distribution and habitat specificity require objective, quantitative data which are rarely available in the reference system customarily used for designating habitat relations. A scheme of habitat description was developed and tested in a variety of situations in Africa and North America based on the selection of a set of measurable features or dimensions, each of which was graduated for quantitative or qualitative evaluation. A procedure for recording measurements in the field is described. Examples are presented showing how quantitative habitat data may be applied in erecting vegetation formulae of various degrees of refinement, in making semi-pictorial habitat diagrams, and in analyzing subtle differences in habitat selection by different species or populations.

188

Endean, F.; Johnston, H.J.;Lees, J.L.
Silvicultural implications of large block clearcutting in Alberta.
Pp. 19-41 in: Some implications of large-scale clearcutting in Alberta: a literature review. Dept. Environ. Can. For. Serv. Info. Rep. NOR-X-6. 1971

KEYWORDS: silvicultural implications;clearcutting: large block;natural regeneration;artificial regeneration;lodgepole pine;Alberta

ABSTRACT: This review of research into the silvicultural problems associated with large block clearcuts has revealed two important considerations: first, that the silvics of the tree species, spruces and pines, are well known; and second, that while the economics of the situation may force the forest manager into the clearcutting of ever increasing areas, there is a marked paucity of research and development trials related to size of clearcut. Existing trials are too often dependent on the current standards of merchantability and utilization. We are forced therefore to make predictions about the silvics of a situation which is not yet the norm but towards which cutting practice is now turned. These predictions are made with justification on the basis of silvicultural and ecological studies, many of which are referred to in this review.

189

Engstrom, K.;
The dependence of the bird fauna on the composition of the forest.
Meddl. Statens Skogsforskningsinstitut 45:1-47 1955

KEYWORDS: avian ecology;avian diversity;avian density;bird-habitat relationships;forest composition;bird-insect relationships;Sweden

ABSTRACT: In the summer of 1952 the author performed a bird census in the area of the Swedish Forest Research Institute at Bogesund, about 12 km NE of Stockholm. The configuration of the area comprised of 5.02 sq km. Of this area, 3.67 sq. km are made up of forests, mostly with spruce and pine as the dominant trees and deciduous trees-mostly birch, alder, and oak-only scattered or in small groves. The area was divided into smaller ones along roads, patches, shores etc., which were mapped and crossed systematically along parallel lines about 50 m apart. This work was carried out from 27/5 to 17/6, generally between 4 and 9 a.m. with completion in the evening and night regarding some species. The number of pairs was chiefly calculated on base of observations of singing males, fledged broods and nests, and each pair observed was plotted on the map. The forest map of this area is divided into 225 small sections, each of which is described regarding the share of each kind of tree, site class, age and density of the forest. The bird population-density regarding as well the total population as the single species was calculated from all sections of the same values of each of these factors. Thus obtained were the abundance (pair/sq km) as well as the dominance (% of the total number of pairs) are considered against the degree of each factor. In this manner the influence of each factor on the distribution of the species can be studied. In chapter IV the bird fauna of the deciduous forest is compared with that of the coniferous forest, and in chapter V the bird fauna of the area is compared with the results from two earlier censuses in northern Sweden. In the tables the species are grouped in "dominants" = D (>5% of the total number of pairs), "influents" = I (2-5%) and "recedents" = R (<2%). In the last chapter the bird census is regarded as the basis of the researches concerning the possibility of a controlling effect of birds upon insect populations.

190

Environment Council of Canada;
The environmental effects of forestry operations in Alberta. Report and recommendations.
Environment Council of Alberta, Edmonton, Alberta. 181 pp. 1979

KEYWORDS: forestry operations;environmental effects;wildlife habitat;wildlife populations;Alberta

ABSTRACT: **A report on the environmental effects of timber harvesting in Alberta. The effects of forestry operations on wildlife habitat and populations, and the related recommendations are very limiting.

191

Erdelen, M.;
Bird communities and vegetation structure: I. Correlations and comparisons of simple and diversity indices.
Oecologia (Bul.) 61:277-284 1984

KEYWORDS: avian ecology;avian communities;avian diversity;vegetation structure;diversity indices;bird-habitat relationships

ABSTRACT: In order to investigate relations between bird community and vegetation structure indices, with a focus on methodological problems, 22 study plots ranging from grassland to old forests were selected. Breeding passerine birds were censused by means of the mapping method. Vegetation structure was assessed by measuring cover values at 12 different heights (0.25 to 32 m). Simple indices (e.g. number of bird species, NRSPEC, and number of layers with vegetation, NSTRAT) as well as diversity values (bird and plant species diversity, BSD and PSD, resp.; foliage height diversity, FHD, and other indices of structural diversity) were calculated. Vegetation structure diversity, but not floristic diversity PSD, was found to be correlated with BSD. However, vegetation structure indices differed in several respects. The much-discussed BSD/FHD correlation held only if structurally different plots (forests and low vegetation) were included in the analysis, but not if the evaluation was restricted to forests alone. The index DT, suggested by Blondel and Cuvillier proved to be more useful, being more highly correlated to BSD, and more robust as to study site selection. It also offers the advantage of discerning between a vertical (DV) and a horizontal (DH) component. Due to methodological divergencies, it was found virtually impossible to make detailed comparisons, in terms of biological concepts, of the results of other authors and those of the present study, the problem of comparability apparently deserving more discussion than it has received hitherto. The designation "FHD", esp., is used for numerical values arrived at by quite divergent field methods and computational procedures. It is concluded that simple indices (e.g. NRSPEC and NSTRAT), which are demonstrated to be good predictors of more complex ones (BSD and FHD, resp.), should be preferred as they permit better standardization and easier, more direct interpretation.

192

Erskine, A.J.;
Birds observed in north-central Alberta, summer 1964.
Blue Jay 26:24-31 1968

KEYWORDS: avian species;habitat preference;annotated list;Alberta:north-central

ABSTRACT: **This paper provides an annotated list of bird species and the most common habitats in which they were observed. In comparison to other earlier records, relative frequency and abundance of birds showed more species characteristic of forested country and fewer birds of open country.

193

Erskine, A.J.;
Birds in boreal Canada
Can. Wildl. Serv. Rep. Ser. No. 41, 73 pp. 1977

KEYWORDS: avian communities;avian diversity;avian densities;avian adaptations;bird-habitat relationship;migratory status;biogeography;mans impact on;boreal forest;Canada

ABSTRACT: *Birds of the boreal regions of Canada were studied over an eight-year period to assemble baseline data on the composition and density of the bird communities in various habitat types. These data, with other material from a variety of sources, now permit an overall review of the boreal avifauna, its composition, evolution, and prospects for survival. All boreal conifer forests share the same community of birds, with some additions or subtractions, whereas much greater differences are found in comparison with conifer habitats of other, nearby regions to the south, where such communities do not form the vegetational climax. The boreal avifauna of Canada includes species with their centers of abundance within this region, and also elements from adjoining regions, particularly the deciduous and transition forest regions to the southeast. Distribution patterns of closely related species pairs and of subspecies within a species indicate the main faunal breaks within the boreal avifauna to be along the line of the Canadian Rockies and between Lake Superior and Hudson Bay; other important breaks along the British Columbia Coast Range and across south-central British Columbia form the southwestern borders of the boreal region as here understood. Few species are confined to boreal conifer forests, and these mostly are of holarctic families, genera, or species. The rest are either of other habitats, or else tolerant of a variety of forest types, particularly the broad-leafed forests of eastern North America in which many families originated. More than 80% of all bird species breeding in or to the north of the boreal region winter farther to the south. Of the migrant land birds, roughly half the species winter south of 30 deg N., in tropical or subtropical regions. The impact of man on boreal birds has been less than in most biomes long settled by man. Extraction of mineral resources has created deserts locally, but as yet nowhere on a scale such as to threaten bird species' existence. Agriculture has also been of minor significance. Trends toward shorter turnover cycles in forestry could threaten mature and particularly old-growth forests, but transportation costs are likely to limit such effects to the more accessible regions. Hydro-electric developments destroy the often fertile riparian communities, though here, too, most of the species involved are widespread and/or tolerant of a variety of habitats. Toxic chemicals threaten a number of raptorial or fish-eating birds which receive high concentrations of these poisons through extended food chains.

194

Erskine, A.J.;
The first ten years of the co-operative Breeding Bird Survey in Canada.
Can. Wildl. Serv., Rep. Ser. No. 42. 61 p. 1978

KEYWORDS: Breeding Bird Survey;population distribution;population trends;environmental correlations;Canada

ABSTRACT: The co-operative Breeding Bird Survey (BBS) has been active in Canada since 1966. This report discusses the first 10 years (1966-1975). The main objectives of the BBS are to detect and measure year-to-year and long-term changes in populations of birds, particularly the smaller land birds. The surveys, carried out by volunteer observers, are based on random sampling and a standardized roadside point-count method, as in parallel surveys in the United States. Analyses are carried out for six major regions - the Maritime Provinces, agricultural southern Ontario and Quebec, forested central Ontario and Quebec, agricultural southern Prairie Provinces, forested central Prairie Provinces, and British Columbia west of the Rocky Mountains. No attempt is made to combine the results for nation-wide indices, because few if any environmental factors act uniformly and concurrently all across an area as large as Canada. There are few sustained downward trends shown by the BBS, and none is clearly correlated with obvious environmental changes.

195

Erksine, A.J.; McLaren, W.D.
Sapsucker nest holes and their use by other species.
Can. Field-Nat. 86:357-361 1972

KEYWORDS: sapsuckers;nest sites;aspen;cavity-tree characteristics;competition;Canada

ABSTRACT: This paper presents additional evidence that Yellow-bellied Sapsuckers commonly nest in aspen trees in early stages of heart rot. In southern parts of their range, where aspens are less common, they also use a wide variety of broad-leafed trees. The selective advantage of the easily excavated interior surrounded by a sound, protective shell of living wood is not obvious in central British Columbia and elsewhere in the northern forests, where potential predators are scarce. Competition from starlings is at present greatly reduced by the ready availability of flicker holes. The large, northern flying squirrel is unable to use sapsucker holes, and use by flying squirrels is confined to the small, southern species.

196
Euler, D.L.; Thompson, D.Q.
Ruffed grouse and songbird foraging response on small spring burns.
N.Y. Fish and Game J. 25:156-164 1978

KEYWORDS: fire: prescribed;avian ecology;post-fire response;bird-insect relationships;fire management;New York USA

ABSTRACT: In the first 30 days following prescribed fires, ruffed grouse and a variety of small birds showed a marked preference for burned areas. Insects made up a greater proportion of the diet of adult ruffed grouse in this study than in any previously reported. Droppings from grouse foraging on recently burned areas indicated a distinctly higher intake of insects than did grouse droppings from unburned (control) areas. Pit-fall traps captured significantly higher number of ground insects in the burned areas than in the control areas.

197
Evans, K.E.;
Forest management opportunities for songbirds.
Trans. N. Am. Wildl. and Nat. Res. Conf. 43:69-77. 1978

KEYWORDS: avian ecology;songbird populations;habitat selection;forest management;silviculture;clearcutting;aerial spray;cluster analysis;management implications

ABSTRACT: I believe that policy of including nongame species in forest management plans and managing for the whole ecosystem is now well established. Seeing and hearing songbirds and knowing that they are present in managed forests are among the many demands now made of our forests by the American people. The goals of the present paper are (1) to quantify vegetation attributes of bird habitat; (2) to relate these associations to current management policies; and (3) to discuss a framework for future management opportunities. The data were collected in Missouri Ozarks but the principles and most of the specifics apply to the extensive inland eastern deciduous forest.

198
Evans, K.E.;
Oak-pine and oak-hickory forest bird communities and management options.
Pp. 76-89 in: R.M. DeGraaf, tech. coord. Proc. of the Workshop: management of southern forests for nongame birds. Jan 24-26, 1978, Atlanta, Georgia. 1978

KEYWORDS: avian ecology;avian diversity;avian succession;forest succession;land use impact;management implications;hardwoods;mixed-hardwoods;USA

ABSTRACT: Successional trends, soil-site characteristics, and land use options in the oak-pine and oak-hickory forest types are discussed in relation to bird populations and bird-habitat associations. Management guidelines are provided. Management alternatives include attracting birds to recreational areas, identifying unique birding areas, managing for ecosystem integrity, and enhancing the habitat for cavity nesting bird species.

199
Evans, K.E.; Conner, N.
Snag management.
Pp. 214-225 in: R.M. DeGraaf and K.E. Evans, tech. coord. Management of north central and northeastern forests for nongame birds. Workshop Proc., Jan 23-25, 1979, Minneapolis, Minnesota. USDA For. Serv. Gen. Tech. Rept. NC-51. 1979

KEYWORDS: snag management;cavity-nesting birds;cavity tree characteristics;tree preference;bird-insect relationships;management implications

ABSTRACT: Thirty-six of the 85 North American cavity nesting bird species occur in the north-central and north-eastern forests. Species richness and density are influenced by the quality and quantity of available snags. Snag abundance is influenced by many land use options including timber operations. We have calculated the snag needs for 9 primary excavators and have related these needs to management options.

200

Ffolliott, P.F.;
Implications of snag policies on management of southwestern ponderosa pine forests
Pp. 28-32 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: snag management;timber harvest;silviculture;stripcut;single tree selection;group tree selection;path-cut;thinning;management implications;economics;Arizona USA

ABSTRACT: The southwestern region of the USDA Forest Service is providing habitat for snag-dependent wildlife species in ponderosa pine forests. To evaluate alternative snag retention policies, study areas representing five silvicultural treatments and virgin conditions were evaluated to determine whether or not they met the policies under present conditions, and if not, whether or not policies would be met through natural mortality in the future.

201

Field, R.; Williams, B.K.
Age of cavity trees and colony stands selected by red-cockaded woodpeckers.
Wildl. Soc. Bull. 13: 92-96 1985

KEYWORDS: red-cockaded woodpecker;colony stands;cavity-tree characteristics;habitat selection

ABSTRACT: *In 1981, we began a study to develop a quantitative model of red-cockaded woodpecker nesting habitat based on the current literature. Because old-growth pine habitat is considered such a central feature of red-cockaded woodpecker biology and management, we looked with special attention at the published data supporting the assertion of tree age as a selected feature in the nesting habitat. We hoped to establish a quantifiable relationship between tree or stand age and habitat selection.

202

Finley, R.B.;
Adverse effects on birds of phosphamidon applied to a Montana forest.
J. Wildl. Manage. 29:580-591 1965

KEYWORDS: phosphamidon;adverse effects;forest birds;forest protection;Douglas fir;Montana

ABSTRACT: A field trial of Phosphamidon applied by aircraft in Montana against spruce budworm had immediate adverse effects on birds. A 5000-acre block of forested land was sprayed at the rate of 1 pound per acre. Some birds, including blue grouse, were killed by the insecticide. Bird activity on the sprayed plot dropped to about one-quarter of the prespray level of activity while it increased on an unsprayed plot. Two sick blue grouse were caught by hand and held in captivity; one died and the other recovered. Analysis of grouse blood samples showed a marked inhibition of cholinesterase activity in the sick birds, followed by return of cholinesterase to normal in the surviving bird.

203

Finney, G.H.; Cadieux, P.;Silieff, E.
The Co-operative breeding bird survey in Canada, 1979
Canadian Wildlife Service, Progress Notes No. 111, 16 pp. 1980

KEYWORDS: Breeding Bird Survey;songbird status;population trends;Canada

ABSTRACT: The results of the 1979 BBS suggest that there are three species in steady and widespread decline across Canada: the eastern race of the Song Sparrow, the Common Flicker and the American Goldfinch. There are no species for which a similar upward trend is notable. The number of routes surveyed continues to be low and the number of routes lost for trend analyses due to lack of comparability was disappointing. Observers are urged to pay strict attention to the rules established for the survey. In 1980 CWS and the U.S. Fish and Wildlife Service will be initiating a three-year assessment of the BBS in North America. The assessment will include an examination of the data collection methods to determine what biases are introduced because of the technique employed, a review of the statistical analysis procedures, and a review of possible additional ways of monitoring the status of non-game birds. We encourage our observers or any other interested people to write to us with their views of the effectiveness and efficiency of the BBS.

204

Fischer, W.C.; McClelland, B.R.
A cavity-nesting bird bibliography-including related titles on forest snags, fire, insects, disease, and decay.
USDA For. Serv., Interm. For. and Range Exp. Stat., Ogden, UT. General Tech. Rep. INT-140 79 pp 1983

KEYWORDS: bibliography;cavity-nesting birds;snags use;fire: effects of;bird-insect relationships;tree decay/disease

ABSTRACT: *This bibliography resulted from a study of the ecological relationships between cavity-nesting birds, forest snags, and decay in western Montana larch-fir forests. Its purpose is twofold: (1) to help forest managers find information they can use to prescribe forestry practices that are sensitive to the needs of cavity-nesting birds, and (2) to help researchers identify existing knowledge gaps.

205

Flack, J.A.D.;
Bird populations of aspen forests in western North America.
Ornith. Monogr. 19 97 pp. 1976

KEYWORDS: avian ecology;bird populations;habitat preference;forest structure;cavity-nesting birds;songbirds;woodpeckers;ground-nesting birds;shrub-nesting birds;aspen forests;North America

ABSTRACT: *Practically all of the quantitative analyses of bird populations in western North America have been restricted to local areas and the habitats studied have not often been described quantitatively. Regional studies have been descriptive in nature. As a result, the ecological relationships of bird populations of the major forest types throughout their entire range are not well known. Therefore, the immediate objective of this study is to analyze quantitatively and to compare systematically the species composition and density of breeding bird populations as they are related to the distribution and structure of monotypic aspen forests in the two areas: a) from Arizona to northern Wyoming, and b) from southwestern Alberta to Manitoba. Quantitative data of this nature are relevant to five problems to which this study is specifically applied: 1. the nature of community organization; 2. factors in forest structure which determine habitat selection; 3. ecological specialization and equivalence in animal communities; 4. relations of forest structure and latitude to diversity in bird populations; 5. the historical and geographical origin of the birds of aspen forests in relation to the establishment of aspen in the western mountains and northern prairies.

206

Forman, R.T.T.; Galli, A.E.;Leck, C.F.
Forest size and avian diversity in New Jersey woodlots with some land-use implications.
Oecologia (Berlin) 26:1-8 1976

KEYWORDS: avian ecology;forest size;forest fragmentation;avian diversity;songbirds;hawks;cavity-nesters;management implications;New Jersey USA

ABSTRACT: The effect of forest size on avian diversity was studied in oak forest patches in rural New Jersey. Number of bird species continued to increase significantly in old oak woods up through 40 ha. This was due to the progressive addition of carnivorous species with increasing minimum forest size requirements. One large woodlot had more species than the same area subdivided into smaller woodlots. To maintain maximum regional diversity more than three large forests are required. Primary land use priority should be to protect large forests. Second priority should be to maintain a high density of small woodlots.

207

Forsman, E.D.; Meslow, E.C.;Strab, M.J.
Spotted owl abundance in young versus old-growth forests, Oregon.
Wildl. Soc. Bull. 5:43-47 1977

KEYWORDS: spotted owl;census;old-growth forests;second-growth forests;habitat preference;management implications;Oregon USA

ABSTRACT: A survey to determine the relative abundance of spotted owls in second-growth and old-growth forests in western Oregon was conducted between 12 July and 11 August 1976. In old-growth, 17 pairs were located in 47 linear km, for an average density index of 0.36 pairs/ km. Five pairs were located in 167 linear km of second-growth survey, for an average density index of 0.03 pairs/km. The 12-fold difference in owl numbers in second-growth indicates that such forests provide, at best, marginal spotted owl habitat. Information on production of young by spotted owls in second-growth forests is needed before the owl's status in such forests can be fully evaluated.

208

Fowle, C.D.;
A preliminary report on the effects of phosphamidon on bird populations in central New Brunswick.
Can. Wildl. Serv. Occ. Pap. No. 7. 54 pp 1965

KEYWORDS: avian populations;spruce budworm control;phosphamidon;post-spray responses;mortality;management implications;New Brunswick

ABSTRACT: *The primary purpose of this project was to assess the effects of phosphamidon on bird populations. It has been shown that: 1. Phosphamidon applied as it was in 1964 in the budworm control program is toxic to birds; 2. Birds are apparently incapacitated or killed mainly as a result of accumulating phosphamidon from sprayed vegetation in the first few hours after spraying. These results should not be used to condemn phosphamidon outright. Under the operational conditions in 1964 phosphamidon killed some birds. We know nothing of what might happen if the dosage were altered, if it were applied earlier in the year, or sprayed in the evening instead of in the morning. We do not really understand how the birds pick up the poison. Certainly the results suggest that the compound should be used with extreme caution until we know more about it, but at the same time, we should recognize that by no means all the possibilities have been explored.

209

Fowle, C.D.;
Effects of phosphamidon of forest birds in New Brunswick.
Canadian Wildlife Service, Dept. Ser. No. 16. 23 pp 1972

KEYWORDS: insecticides;phosphamidon;spruce budworm control;avian ecology;post-spraying response;management implications;New Brunswick

ABSTRACT: The research reported here was undertaken when replacements for DDT and other organochlorine insecticides were being sought. The organophosphate compounds, of which phosphamidon is one, appeared to be promising candidates. As little was known of how these newer insecticides would affect birds, it was important to assess the one which might be used over millions of acres on New Brunswick forests. The effects on birds of the operational use of phosphamidon is a spruce budworm control program in the forests of New Brunswick were assessed. Emissions from spray aircraft of greater than 0.25 lb./acre (0.28 kg/ha) may be hazardous to birds, especially with fine atomization of the spray. Field observations and experiments with captive birds confirmed that lethal or intoxicating doses may be absorbed through the feet from sprayed vegetation or may be ingested. The oral lethal dose for small forest birds seems to lie between 1 and 3 mg/kg.

210

Fowler, N.E.; Howe, R.W.
Birds of remnant riparian forests in Northeastern Wisconsin.
18:77-83 1987

KEYWORDS: avian ecology;forest fragmentation;riparian forest;forest interior birds;habitat structure;discriminant analysis;management implications;Wisconsin USA

ABSTRACT: *Significant numbers of forest interior birds occur even in unexpectedly small riparian remnants. Width of these riparian areas rarely exceeds 500 m, even though the total area of contiguous forest is >100 ha. Forest birds of riparian fragments did not precisely reflect bird assemblages in the larger forest tract, yet only two species characteristic of lowland forests were absent in the isolated fragments. Stepwise discriminant analysis identified habitat characteristics that are significantly associated with the presence or absence of ovenbirds and wood thrush, two common species which are considered to be sensitive to forest extent. Results suggested that ovenbirds were more sensitive than wood thrushes to forest fragmentation.

211

Fox, R.; Rhea, B.
Spotted owls in the Rockies.
J. Forestry 87:41-45 1989

KEYWORDS: spotted owls;habitat characteristics;home range;timber management;wildlife-timber harvesting conflict

ABSTRACT: *Spotted owls in the Southwest have a recorded history dating bock to 1892, although generally very little has been written about them and they have attracted little attention. But in July 1987, this situation changed radically when a pair of owls with young were confirmed in the midst of the Penway Timber Sale on the Lincon National Forest in southern New Mexico. Subsequent studies and policies are now opening a major new arena in the widening controversy over endangered species management. The difficulty questions raised concerning the spotted owl's use of old-growth forests may well change forever the approach to timber management in the Southwest.

212

Francis, J.; Lumbis, K.
Habitat relationships and management of terrestrial birds in northeastern Alberta.
Unbubl. report prepared by Canadian Wildlife Service for Alberta Oil Sands Environmental Research Program. Project LS 22.1.1. 365 pp. 1979

KEYWORDS: avian ecology;avian diversity;avian density;bird-habitat relationships;habitat preferences;habitat disturbance;mitigation;management implications;Alberta

ABSTRACT: Breeding bird studies using the mapping method were combined with intensive habitat quantification to determine the relative values to breeding avifauna of 21 habitat types. The large plot sizes allowed division of many plots into subplots, from which the value of certain habitat variations were induced. An annotated list of bird species was prepared, giving the status and phenology of all bird species observed in the study area. Suitable and preferred habitats are detailed for each bird species, as well as the population densities found in studied habitats. Potential impact of oil sands development is detailed, and recommendations as to how to minimize that impact are included. Guidelines for reclamation of developed areas are suggested.

213

Franzreb, K.E.;
The effects of timber harvesting on an avian community in a mixed-coniferous forest, White Mountains, Arizona.
Ph.D. Diss. Ariz. State Univ., Temple. 205 pp 1975

KEYWORDS: overstory removal;post-logging responses;bird-habitat relationships;avian diversity;avian density;foliage volume;residual components;foraging behaviour;management implications;mixed-coniferous forest;Arizona USA

ABSTRACT: The effects of an overstory removal form of timber harvesting on avian populations were examined in a mixed-coniferous forest, White Mountains, Arizona, during the summers of 1972, 1973, and 1974. Avian species composition and densities varied between the control and the logged areas and indicated a higher total density in the undisturbed habitat. However, a number of species attained higher densities in the modified than in the control site. Total bird use of the available foliage in the unmodified area for all tree species combined indicated that foliage was used approximately in the proportion it was available. However, this was not so for individual tree species. Total foliage volume use in the harvested area indicated decided avian selection of certain foliage. Location preferences (upper, middle, or lower portion of each tree species) appeared correlated to amount of foliage available. In both habitats avian usage of Douglas-fir, white fir, and Engelmann spruce far exceeded that expected on the basis of foliage volume. In the logged area, birds more frequently were observed on snags, dead trees and in quaking aspen than in the control site. Gray-headed Juncos heavily utilized slash (logging debris). In both habitats tall trees were preferred. Notable variations in foraging behavior components occurred whereby some species became more diverse in their utilization of certain aspects of the environment while others became more specialized. The behavior of five avian species: Yellow-bellied Sapsucker, Mountain Chickadee, Ruby-crowned Kinglet, Yellow-rumped Warbler, and Gray-headed Junco was examined with regard to foliage use pattern, tree species selection, tree height preferences, location preferences, and foraging behavior. For some species studied the overall behavior subsequent to timber harvesting was modified. For others, habitat modification procedures such as overstory removal, had little, if any effect on them.

214

Franzreb, K.E.;
Bird population changes after timber harvesting of a mixed conifer forest in Arizona.
USDA For. Serv., Rocky Mount. For. and Range Exp. Stat. Res. Paper RM-184. 26 pp. 1977

KEYWORDS: avian ecology;avian diversity;avian density;tree preferences;logging;post-logging responses;habitat structure;management implications;mixed conifer;Arizona USA

ABSTRACT: *Timber harvesting (selective overstory removal) in the White Mountains of Arizona was detrimental to some bird species, but was beneficial to others. The number of avian species in the harvested and control areas was similar. In 1973 there were 30 species in the harvested area and 29 in the control area, whereas in 1974 there were 35 species in each study site. Species composition and densities varied considerably between the two study areas. Several species such as the Coues' flycatcher, purple martin, and western bluebird, were restricted to the harvested site. This area was also more suitable for the red-tailed hawk, American kestrel, yellow-bellied sapsucker, olive-sided flycatcher, violet-green swallow, house wren, and gray-headed junco. Conversely, the unharvested area was preferred by the western flycatcher, brown creeper, golden-crowned kinglet, ruby-crowned kinglet, yellow-rumped warbler, red-faced warbler, and hermit thrush. Total densities were considerably higher in the unharvested habitat each summer. Population size may be determined by a number of factors, including foliage volume, nest site availability, degree of predation, microclimate, and food abundance. Some birds showed strong preferences for certain tree species, while other trees were less frequently used. In both the harvested and unaltered habitats, birds most frequently visited Douglas-fir, white fir, and Engelmann spruce, which were utilized in excess of the proportion of volume each comprised in the environment. Usage of quaking aspen and snags was higher in the logged area. Ponderosa pine and southwestern white pine were frequented less than would be predicted on the basis of foliage volume. By leaving more trees of the most desirable species, a harvested habitat may be capable of supporting more birds of some species than it would otherwise. Tall trees were preferred in both habitats, undoubtedly because they provided more foliage volume. The yellow-rumped warbler and ruby-crowned kinglet predominantly selected tall and very tall trees. Thus, some tall trees should be left. Slash piles were very important, especially for gray-headed juncos and, to a lesser extent, for house wrens. To prevent a reduction of these species, at least some slash piles should be allowed to remain after a harvest. Snags were a vital habitat component for many species, particularly those that nest in cavities (violet-green swallows, mountain chickadees, house wrens). Birds use snags for foraging, observing, preening, singing, and nesting. The majority of nests observed in the logged area were in snags. Many nests, especially those in the middle or top of spruce and fir, were not found. Apparently, the relative abundance of snags as well as ease of finding food attracted such aerial foragers as the violet-green swallow to the logged area. There was evidence of severe competition for suitable nest cavities in snags; numbers of such cavities may play a vital role in population regulation of some species.

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Franzreb, K.E.;
Tree species used by birds in logged and unlogged mixed-coniferous forests.
Wilson Bull 90:221-238 1978

KEYWORDS: habitat disturbance;logging;post-logging response;habitat selection;tree species preference;avian ecology;mixed-coniferous forest;management implications;Arizona USA

ABSTRACT: Variation in avian selection of tree species in a community which had undergone an overstory removal form of timber harvesting was compared to a virgin, mixed-coniferous forest, in the White Mountains, Arizona, during the summers of 1973 and 1974. Tree species preferences for all birds observed indicated Douglas-fir, white fir, and Engelmann spruce were the most frequently visited species in both habitats and were used in both the unmodified and logged areas in excess of the proportion of foliage volume they contained in the entire habitat. Ponderosa pine and southwestern white pine were frequented less than expected on the basis of availability. Although aspen constituted over 50% of the available foliage in the harvested habitat, birds did not appear to compensate for the reduction in density of firs and spruces by increasing their use of it. Whereas some species in the modified environment, such as the Mountain Chickadee, became more generalized and therefore less selective as to tree species, the Ruby-crowned Kinglet apparently became more restricted, and hence, more specialized in tree species preferences. Use of quaking aspen, the only species not removed during harvesting, and snags (dead trees) was higher in the modified than in the unaltered habitat.

216

Franzreb, K.E.;
A comparison of avian foraging behavior in unlogged and logged mixed-coniferous forest.
Wilson Bull. 95:60-76 1983

KEYWORDS: avian ecology;foraging behavior;habitat disturbance;logging;post-logging response;habitat structure;tree species preference;mixed-coniferous forest;Arizona USA

ABSTRACT: Foraging behavior of five avian species was compared in a recently logged mixed-coniferous forest (selective overstory removal) and a natural forest. The structure and profile of the vegetation in the two forest types differed, with the logged area possessing a different tree-species, foliage-volume distribution, far more open canopy cover, and a greater ground surface complexity resulting from abundant slash. In the timber harvested plot, foliage volume, mean tree height, and overall tree density were substantially reduced. In the logged plot some species responded by reducing foraging heights and using shorter trees. Tree species selection varied significantly (P<0.05) for all avian species when comparing tree species use to tree species availability based on relative frequencies and also when contrasting use in unlogged vs logged areas. The distribution of foliage volume by tree species was considerably different in the two plots. Aspen comprised over 53.1% of the total foliage volume in the logged area vs 5.0% in the unlogged. Use of aspen in the logged plot increased at least twofold for the Yellow-bellied Sapsucker, Mountain Chickadee, and Yellow-rumped Warbler. In the logged area the increase in degree of generalization for the Yellow-rumped Warbler was more pronounced than for any other species. In contrast, the Ruby-crowned Kinglet was quite stereotyped in its foraging and even more so in the harvested area; this coupled with substantially greater specialization in the warbler, was reflected in a reduction in niche overlap between the kinglet and both the chickadee and Yellow-rumped Warbler in the logged site. The results of this study suggest that changes in foraging behavior such as those observed for tree species selection, foraging substrate, tree height use, and foraging height, reflect a shift in vegetation structure and distribution and/or availability of resources.

217

Franzreb, K.E.; Ohmart, R.D.
The effects of timber harvesting on breeding birds in a mixed-coniferous forest.
Condor 80:431-441 1978

KEYWORDS: avian ecology;habitat disturbance;habitat heterogeneity;logging;post-logging responses;breeding birds;avian density;avian diversities;mixed-coniferous forest;Arizona USA

ABSTRACT: Avian species composition and densities in a mixed-coniferous virgin forest and in a similar area that sustained a moderately heavy overstory removal form of timber harvesting were examined in the White Mountains in Arizona during the summers of 1973 and 1974. The unlogged plot supported significantly ($P<0.05$) more individuals than did the logged plot (88.9 birds/ 40 ha more in 1973; 153.5 birds/40 ha more in 1974). The harvested plot supported far fewer tree-foliage searching species. Timber-gleaning species and those that nest in foliage were significantly denser in the unlogged plot. The effect on cavity nesters depended largely on their foraging behavior. Mountain chickadees, which usually nest in snag cavities and forage mainly on live vegetation and bark, were significantly less abundant in the logged plot, whereas woodpeckers which forage on both live and dead trees were equally abundant in both plots. Aerial foragers as well as birds that used slash, benefited by the lumbering. This selective logging led to an increase in tree species diversity, and no appreciable change in diversity of foliage height, tree volume, or bird species. Nevertheless, the modified plot, while containing approximately the same number of avian species, supported a far smaller total population. The amount of foliage available undoubtedly exerts a strong influence on avian species composition and densities because it furnishes nesting sites and foraging substrate. The virgin forest provided substantially more foliage (113984.0 cu meters/ha vs. 15269.8 cu meters/ha) than did the logged plot. Along with foliage volume and configuration, presence of suitable numbers of snags and significant amounts of slash also were important.

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Freedman, B.; Beauchamp, C.;McLaren, I.A.;Tingley, S.I.
Forestry management practices and populations of breeding birds in a hardwood forest in Nova Scotia.
Can. Field-Nat. 95:307-311 1981

KEYWORDS: habitat disturbance;clearcutting;thinning;strip-plot;post-logging responses;avian diversity;breeding bird densities;hardwood forest;Nova Scotia

ABSTRACT: Effects of forestry practices on the breeding birds of a hardwood forest in Nova Scotia were studied. Total breeding density on three uncut control plots was (x + SD) 663 + 145 pairs/sq km. Total breeding densities on three plots clear-cut 3-5 yr earlier were somewhat lower (588 + 155 pairs/sq km), as were the densities on one thinned plot (550 pairs/sq km) and on two strip-cut plots (475 and 575 pairs/sq km), but differences between treatments were not statistically significant. Marked differences, however, occurred in the species composition of the bird communities in the various plots. The most important breeding species on the control plots were Least Flycatcher and Ovenbird. In the clear-cut plots the bird community was dominated by Chestnut-sided Warbler, Common Yellowthroat, and White-throated Sparrow. The species mixtures of the thinned and strip-cut plots were intermediate between those of the control and clear-cut plots.

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Freedman, B.; Morgan, K.;Crowell, M.;Beauchamp, C.;Green, A.
Preliminary observations of breeding birds and vegetation in a post-clearcutting secondary succession in a hardwood forest in Nova Scotia.
Unpublished report prepared by the Dept. of Biology and Institute for Resource and Environmental Studies, Dalhousie Univ., Halifax. 1982

KEYWORDS: avian diversity;avian density;clearcutting;secondary succession;post-logging responses;hardwood forest;Nova Scotia

ABSTRACT: This study involves a description of breeding bird communities in plots of different ages in a post-clearcutting secondary succession in a hardwood forest region of Nova Scotia. In the first season of this study, plots of ages 1, 3, 6, 8, 13, 20, 74 and 74 years old were censused for breeding bird density, diversity and richness. In addition, the plant communities of each of these plots was described, in order to quantify habitat characteristics. The data for the first year indicate no marked changes in breeding bird density, diversity or richness for plots older than 1 year, but there were marked changes in species composition. The younger plots were dominated by Chestnutsided Warbler, Common Yellowthroat, Dark-eyed Junco, White-throated Sparrow and Song Sparrow. The mature plots were dominated by Least Flycatcher, Hermit Thrush, Veery, Red-eyed Vireo, Northern Parula, Black-throated Green Warbler, Ovenbird and American Redstart.

220

Freemark, K.E.; Merriam, H.G.
Importance of area and habitat heterogeneity to bird assemblages in temperate forest fragments.
Bio. Conserv. 36:115-141 1986

KEYWORDS: forest size;forest fragmentation;habitat heterogeneity;avian ecology;avian diversity;spatial distribution;forest-interior birds;edge-related birds;management implications;Ontario

ABSTRACT: Relationships among area, habitat heterogeneity and bird assemblages were examined for 21 forest fragments (3 to 7620 ha) in an agricultural landscape near Ottawa, Canada. Habitat heterogeneity within forests was measured by an index of spatial variability (HH) in plant species and forest structure. HH based on tree species or shrub species increased with forest size. Larger and more heterogeneous forests had more species and pairs of birds, according to multiple regressions for two summers combined. Number of species and pairs of birds at individual points within forests increased with greater HH but not with larger size. Birds also were more patchily distributed in more heterogeneous, but not necessarily large, forests, because of relatively uncommon species. Larger forest size was more important for increasing species number in forest-interior and resident-related classes of birds. Some classes, eg. forest interior species, were infrequent in smaller forests. Habitat heterogeneity was more important to edge-related classes. To maintain a diverse forest avifauna, regional conservation strategies should maximize both size and habitat heterogeneity of forests.

221

Frissell, S.;
The impact of firewood cutting on hole nesting birds.
West. Wildlands 4:28-30 1984

KEYWORDS: habitat disturbance;firewood cutting;cavity-nesting birds;snags;snag management;management implications

ABSTRACT: **Snags and down logs constitute a valuable wildlife habitat resource. This paper discusses the use of dead trees and logs by birds, the impact of prewood cutting on these resources, and provides a number of guidelines which would reduce firewood cutters' negative impacts.

222

Fry, K.;
Summer bird use of the Carnation Creek Watershed, Vancouver Island, British Columbia, 1981.
Unpublished report prepared for Canadian Wildlife Service, Pacific and Yukon Region, Vancouver, B.C. 1982

KEYWORDS: avian diversity;avian density;clearcutting;fire: prescribed;scarification;post-logging responses;bird-habitat relationships;British Columbia

ABSTRACT: **In 1981 the Canadian Wildlife Service initiated a study at Carnation Creek to determine the effects of logging practices on British Columbia avifauna. Surveys of breeding birds were conducted using the fixed-width line transect method. Areas surveyed included a watershed that had been almost entirely logged since 1975, and an unlogged portion of the watershed. Forest cover prior to logging was overmature timber dominated by western hemlock and amabilis fir. Areas clearcut after 1978 were left untouched after tree removal. Areas cleared prior to 1979 were burned and scarified and had been revegetated by the time of the study. Three bird species were unique to the forest area, 5 species were unique to the clearcut area, and 6 species utilized both habitats. Most conifer-nesting species were absent in clearcuts, though some forest species used these areas for foraging. Bird habitat in recent clearcuts is marginal, especially if slash is left unburned. However, logged areas may be very useful to shrub-nesting communities at later stages of succession.

223

Fuller, R.J.; Moreton, B.O.
Breeding bird populations of Kentish sweet chestnut Castanca sativa coppice in relation to the age and structure of the coppice.
J. Appl. Ecol. 24:13-27 1987

KEYWORDS: avian diversity;chestnut coppice;cutting cycle;bird-habitat relationships;avian succession;forest succession;migratory status;England

ABSTRACT: 1)Breeding birds were counted annually for 10 years in 22 ha of sweet chestnut coppice. All stages from freshly cut coppice to more than 19 years of growth were studied. 2) Bird species varied greatly in their preferred stages of coppice growth and in their habitat amplitude (i.e. the range of coppice growth stages they occupied). Species with a narrow habitat amplitude were confined to young coppice. 3) Warblers, finches and buntings were most abundant in young coppice but thrushes and tits increased with the age of the coppice. Migrants were strongly associated with the younger, relatively open coppice. 4) Three broad phases of coppice development, each differing in bird species composition, were identified: establishment (0-3 years of growth), canopy-closure (4-10 years) and maturation (11 years and over). 5) Diversity, as measured by species richness and an index of dominance, decreased with the age of the coppice. Species richness markedly declined at the time of canopy-closure. 6) The physical structure of commercial sweet chestnut coppice is substantially different from that of other types of broad-leaved coppice so that the successional changes in bird communities observed in the present study are unlikely to be directly applicable to other types of coppice.

224

Gage, S.H.; Miller, C.A.
A long term bird census in spruce budworm-prone balsam fir habitats in Northwestern New Brunswick.
Maritimes For. Res. Cent., Infor. Rep. M-X-84, Fredericton, N.B. 1978

KEYWORDS: spruce budworm;bird-insect relationships;avian diversity;avian density;coniferous forest;New Brunswick

ABSTRACT: A long term bird census was conducted in five plots located in largely balsam fir stands of northwestern New Brunswick. During part of the 22 year census, two of the plots were heavily infested with spruce budworm, and suffered extensive tree mortality. Nineteen bird species were common to all plots; differences in their densities, relative to forest cover and presence of budworm as a food supply, are presented.

226

Gale, R.M.;
Snags, chainsaws and wildlife: one aspect of habitat management.
Pp. 97-111 In: Calif.-Nevada. Fourth Annu. Jt. Conf. Am. Fish. Soc./Wildl. Soc. 1973

KEYWORDS: snags;snag characteristics;snag use;logging: effects of;management implications;Douglas-fir;fir;pine: ponderosa;conifer: mixed;California USA

ABSTRACT: Four important timber producing plant communities of the Northwest (Douglas-fir, true fir, ponderosa pine and mixed conifer) were sampled to determine intensity of snag utilization by wildlife for cavity nesting and piciformes feeding. Samples were analyzed, by habitat types, to determine snag occurrences (on a per acre basis) and species of snag preferred. Utilization relative to five snag characteristics (hardness, height, dbh, bark and limb conditions) was analyzed. Recommendations are given regarding minimum number of snags to be left in logging operations for each community. Samples were considered too small for statistical analysis.

227

Galli, A.E.;
Bird species diversity and the size of oak woods in central New Jersey.
M.S. Thesis., Rutgers Univ., New Brunswick, New Jersey. 1974

KEYWORDS:

ABSTRACT: not reviewed

228

Galli, A.E.; Leck, C.F.;Forman, R.T.T.
Avian distribution patterns in forest islands of different sizes in central New Jersey.
Auk 93:356-364 1976

KEYWORDS: forest size;forest fragmentation;forest structure;avian ecology;avian diversity;forest edge;management implications;New Jersey USA

ABSTRACT: We studied 30 forest islands varying in size from 0.01 to 24 ha in central New Jersey to determine the relationship between forest size and bird species richness, the importance of the forest edge, and the minimum habitat requirements of bird species. We made the following conclusions: (1) Forest size has a significant effect on number of bird species, and a parabolic regression equation describes the relationship with R = 0.92. (2) Size of the forest had no significant effect on foliage height diversity, so the bird species richness pattern here is likely a result of area itself, not internal environmental heterogeneity. (3)Bird species richness increases significantly through an island size of 24 ha and is likely to continue increasing significantly at forest sizes beyond 24 ha. (4) Woods of 0.2 ha contained forest edge birds only, while forest interior species began appearing at 0.8 ha. Almost half of the bird species were considered size-dependent, requiring a large area and/or forest interior. Carnivores, including insectivores, were mostly size-dependent. (5)For land use considerations, larger forest patches are essential to maintain a complete regional avian community.

229

Garrison, G.A.; .
Uses and modifications for the "moosehorn" crown closure estimator.
For. Chron. 23:222-235 1947

KEYWORDS: "moosehorn";crown closure estimator

ABSTRACT: *The "moosehorn", a new instrument developed in Canada, has been tested on eastern Oregon forested ranges, and, with modifications, found useful for measuring percentage crown closure or crown cover. It is simple to use. All that is involved in many applications is to hold the instrument in a vertical position, look through a side aperture, and count the number of dots on a transparent upper surface that are covered by tree crown.

230

Gary, H.L.; Morris, M.J.
Constructing wooden boxes for cavity-nesting birds.
USDA For. Serv. Rocky Mountain Forest and Range Exp. Stn., Research Note RM-381. 7 p. 1980

KEYWORDS: artificial nest boxes;cavity-nesting birds;box design

ABSTRACT: Construction details for two sizes of nest boxes are described. In field trials, eight species of cavity-nesting birds nested in the smaller boxes and five species, in addition to red squirrels, raised young in the larger nest boxes. Nest boxes will never replace natural cavities found in live trees and snags. However, when few or no trees with natural cavities are available, nest boxes can help meet cavity requirements and help maintain diversity and populations of cavity-nesting birds.

231

Gates, J.E.; Mosher, J.A.
A functional approach to estimating habitat edge width for birds.
Am. Midl. Nat. 105:189-192 1981

KEYWORDS: avian habitat;habitat edge;forest structure;width determination

ABSTRACT: Two functional approaches toward estimating habitat edge width are proposed. These methods rely upon the dispersion of nests of bird species associated with edge habitat. Field data collected in central Michigan are used to compare and contrast the two methods with habitat edge width determined structurally. The results provide an ecologically more meaningful estimate of edge width. Particular applications are discussed.

232

Gauthreaux, S.A. Jr.;
The structure and organization of avian communities in forests.
Pp. 17-37 in: R.M. DeGraaf, tech. coord. Proc. of the Workshop: management of southern forests for nongame birds. Jan 24-26, 1978, Atlanta, Georgia. 1978

KEYWORDS: avian ecology;;avian organization;avian diversity;avian succession;forest succession;bird habitat relationships

ABSTRACT: The structure of bird communities is presented in the context of Southwood's scheme of ecological strategies and the habitat templet. Heterogeneity in space and time and their effects on the gradients of durational stability and of resource level and constancy are considered the underlying factors in community organization. These gradients are used in discussing species strategies and life forms, community process (succession), and community characters (spatial complexity, trophic complexity, niche breadth, standing crop, turnover, and diversity).

233

George, J.L; Mitchell, R.T.
Calculations on the extent of spruce budworm control by insectivorous birds.
J. For. 46:454-455 1948

KEYWORDS: insectivorous birds;spruce budworm control;forest management;New York USA

ABSTRACT: During June-July, 1946, studies were made at Lake Clear Junction, N.Y. to determine the effect of feeding nestling birds on DDT killed larvae of the spruce budworm. In this connection some information was gathered on the probable degree of control of the spruce budworm outbreak by birds.

234

Gerell, R.;
Faunal diversity and vegetation structure of some deciduous forests in South Sweden.
Holarctic Ecology 11:87-95 1988

KEYWORDS: Managed forests;uneven-aged forest;even-aged forest;forest succession;forest structure;avian ecology;avian diversity;Sweden

ABSTRACT: The relationships of faunal diversity and vegetation structure were studied in twenty deciduous forest plots in South Sweden, all of them managed. Following animal groups were censused: Shrews, bats, voles, fieldmice, birds, groundliving beetles, spiders, and harvestmen. The analysis of the 22 vegetation variables was made by means of repeated and rotated PCA. Rarefaction was used to ordinate the bird species richness of the different forest plots. The multivariate vegetational analysis resulted in three distinct and readily interpretable components: horizontal and vertical spatial heterogeneity, and mean basal area. The number of small mammal species (except bats) was greatest in forests with great amount of understory while the number of bat species increased with increasing mean basal area. The number of bird species in a fixed number of territories was also highly correlated with the mean basal area. Hence, maximum bird species richness was obtained in nature forests but not in those with greatest vertical heterogeneity. The invertebrate communities showed very few distinct relationships to the vegetation structure. Dominance decreased as vegetation complexity increased. Dominance also decreased with increasing species richness in all faunal communities studied.

235

Germain, P.; Morin, G.
Forest songbird population 1978 monitoring program in relation to aerial spray of insecticide against spruce budworm.
Avifauna Ltee/Ltd. Moncton, N.B. Rept. to For. Prot. Ltd. and N.B. Dept. Natur. Res. IV + 31 pp. + append. 1979

KEYWORDS:

ABSTRACT: not reviewed

236

GERMAIN, P.; Tingley, S.
Population responses of songbirds to 1979 forest spray operations in New Brunswick.
Avifauna Ltee/Ltd., Moncton, N.B. Rept. to For. Prot. Ltd. 38 pp. + append. 1980

KEYWORDS:

ABSTRACT: not reviewed

237

Giles, R.H.;
Timber-wildlife coordination concepts for large eastern forests.
Trans. N. Amer. Wildl. Conf. 27:402-412 1962

KEYWORDS: forest management;wildlife management;coordination approaches;problem solving

ABSTRACT: *This paper attempts to solidify and clarify basic timber and wildlife management coordination approaches and problems and presents concepts and proposals for solving these problems. Major emphasis is on National Forest management but the concepts are applicable to most large forests. Concepts presented and discussed were: conservation necessitates concession; though oppressively complex, coordination demands effort; universities producing single-resource specialists must insure that they are also conservationists; resource abuses today on the large forest are largely committed by the specialist; present staffs need training, strong policy, and forceful leadership to suppress existing special interests; foresters contending their job is to provide maximum economic forest product yields, deny the principle of conservation; mutual trust and respect are required between personnel besides total subjugation of personality problems for the good of the cause. Failure of wildlife managers to imaginatively use existing information for forest game management directives is discussed with the managers blamed for not seeking needed literature and waiting for 'research staffs' to do their work, and administration blamed for harboring the attitude that the manager's only good day is a day in the woods. A climate for wildlife leadership has recently been created. The question is raised: will wildlifers, who for years have criticized foresters for not doing more for wildlife, meet the needs? Emphasis from the active "clearings, waterholes, and conifer clumps" to the passive "refrain from certain forest practices" is encouraged. Need for an extensive written plan for management coordination on a watershed basis is stressed. The advantages of the watershed approach are described along with outlines for "prescriptions" for management and land use within them. The concept that all forms of game cannot be managed or provided for on every acre is presented with an illustrated example of planning for coordination of timber and wildlife on a large Forest Service ranger district. Small watersheds are assigned game species and wood-use priorities for management. Extensive planning cannot make land management a "cook book" activity in the future. As land and human population demands are dynamic, so must the plan be to reach sound conservation objectives.

238

Gill, J.D.; DeGraaf, R.M.;Thomas, J.W.
Forest habitat management for non-game birds in central Appalachia.
USDA Forest Service, Northeastern Forest Experiment Station, Research Note NE-192, 6 p. 1974

KEYWORDS: songbirds;nesting habitat;habitat management;artifices;management practices;Virginia USA

ABSTRACT: To woodland owners or managers who are interested in bird-habitat improvement, the authors suggest managing for: (1) people with slight to moderate knowledge of birds; (2)high numbers of both individual birds and bird species, particularly the conspicuous species; (3) seeing and hearing birds near trails and other human-activity areas; (4)bird nesting; and (5)natural-appearing habitat. The nesting-habitat preferences of 31 representative species are listed. Guidelines are offered for trails, sites, plants, growth stages, dimensions and lay-out, and treatments.

239

Glowacinski, Z.;
Succession of the bird communities in the Niepolomice Forest (Southern Poland).
Ekologia Polska 23:174-183 1975

KEYWORDS: avian ecology;avian succession;avian community organization;avian diversity index;forest succession;forest structure;ecotone effects;Poland

ABSTRACT: Structural changes in avifauna in the succession from an old river bed to a climax oak-hornbeam forest (series A) are expressed in the progression of the number of species (N) and their density (D), and in the increasing and later fairly uniform course of species diversity (H'). Under the study conditions the climax ending successional series of deciduous forests (series A) and coniferous forests (series B) may be the oak-pine forest stage. The bird community formed there reaches its highest organization (H'). The succession of birds in a clearing differs from Margalef's (1968) theoretical model of succession, and passes through two phases. The ecotone exerts an effect on the bird community in the transition between these phases. In the succession in the clearing the climax community exhibits a rather slight decrease in H' and greater annual fluctuation in value D than is the case in the preclimax community. This is due to the spatial development of the habitat. The change in the organization of bird communities takes place abruptly in transition from a habitat with a single layer of vegetation into 2 and 3 layer vegetation.

240

Glowacinski, Z.;
Some ecological parameters of avian communities in the successional series of a cultivated pine forest.
Buletin de l'Academic Polonaise des Sciences, Series des sciences biologiques. Cl II, 27:169-177 1979

KEYWORDS: post-logging response;avian succession;avian diversity;avian density/biomass;clearcutting/cultivation;forest succession;bird-habitat relationships;pine forest;Poland

ABSTRACT: Using the comparative method, the author describes the secondary succession of birds inhabiting a semi-natural pine forest from its clear-cut to pre-climax stages (I-V). In the course of succession there follows an uneven increase in the number of species (S), density (N), species diversity (H'), standing crop biomass (SC), and intensity of specialization of bird species (I.SPEC). On the other hand, the rate of succession (TRN) decreases so that at its initial stage it is thirty times higher than at the pre-climax stage. At the final stage there occurs a marked relative growth of the share of the species subjected to selection of the type K. The bird species considered as strict K-strategists show a body weight twice greater than that of the "strict r-strategists". On the whole, these results are in accordance with theoretical speculations.

241

Glowacinski, Z.; Jarvinen, O.
Rate of secondary succession in forest bird communities.
Ornis Scandinavica. 6:33-40 1975

KEYWORDS: forest bird communities;avian succession;forest structure;bird-habitat relationships;diversity indices;Poland;Finland

ABSTRACT: The rate of secondary succession in forest birds has been quantified on the basis of the Jaccard, Sorensen, and Renkonen indices, and of an index derived from Shannon's measure of diversity. All indices give very similar results. In the Polish oak-hornbeam forest the rate of succession (TR) decreases monotonously with time, but in Finnish coniferous forests (spruce and pine) the TR curves have a peak after 5-25 years from the beginning. The climax characteristically has a turnover rate of less than 10 percent from that of the initial stages. The logarithms of TR can be expressed satisfactorily as linear functions of time. This is probably not true of TR curves for primary succession, owing to a lengthy period of soil development in primary succession.

242

Glowacinski, Z.; Weiner, J.
Successional trends in the energetics of forest bird communities.
Holarctic Ecology 6:305-314 1983

KEYWORDS: Forest bird communities;avian succession;bird-habitat relationships;energetics;avian diversity;natural forest;managed forest;Poland

ABSTRACT: Thirty forest bird communities were studied with regard to the changes in structural indices (number of species, density, biomass, species diversity H') and in energetics (energy flow A, production P, ecological efficiency P/A) in temporal and spatial gradients. All these characteristics increased during temporal succession; in natural deciduous forests there is a two-peak pattern of the increase, with the maximum in 15-20 yr old forest ("time ecotone"; A = 692.9 Megajoules/ha/season, H' = 4.2 bits). In artificially managed pine forest these indices rise monotonically, reaching a maximum in sub-climax (A = 426.2 Mj/ha/season, H' = 4.2 bits). In a deciduous forest a tendency exists to decrease the ecological efficiency (from 8% to 2%), while in a coniferous stand this variable remains low (2%) and almost constant during succession. In a spatial gradient, the highest values of energy flow and species diversity occur in forest stands with moderate soil/water regime and of ecotonal character (A = 851.2 Mj/ha/season, H' = 4.5 bits). All mature forest bird communities show similar values of diversity (4.2-4.5 bits) and ecological efficiency (appr. 2%), though they differ in the rate of energy flow. The relation of these findings to the current concepts of ecological succession are discussed.

243

Godell, B.S.; Kimball, A.;Hunter, M.L., Jr.
Application of wood science to the creation and maintenance of snags for wildlife.
Pp. 135-139 in: J.A. Bissonette, ed. Is good forestry good wildlife management? Proc. of a Joint Conference, March 6-8, 1985, Portland, Maine. 1986

KEYWORDS: snags;unmerchantable trees;snag management;techniques;fungus;girdling;management implications

ABSTRACT: With an increase in intensive forest management practices in the next two decades there will be a reduction in the availability of wildlife habitat in the form of snags. It is therefore important that we develop methods of creating snags from unmerchantable trees in areas where needed. In this paper, we review methods for selecting unmerchantable trees that are potential snags, and outline some techniques that could be integrated with forest management plans for preserving and/or creating wildlife habitat trees.

244

Gotfryd, A.; Hansell, R.I.C.
Prediction of bird-community metrics in urban woodlots.
Pp. 321-326 in: J. Verner, M. Morrison, and C.J. Ralph, eds. Wildlife 2000: Modeling habitat relationships of terrestrial vertebrates. Univ. of Wisconsin Press, Madison, WI. 1986

KEYWORDS: model;habitat variables;bird-community metrics;model predictions;avian diversity;avian density;management implications

ABSTRACT: Birds were censused and the habitat sampled for 19 patches of deciduous forest in the vicinity of Toronto, Canada. Linear regression was used to find subsets of 21 habitat variables for precisely predicting the species richness, abundance, and density (pairs/ha) of breeding birds. The length of plot edge accounted for 82% of species richness and 96% of abundance variation. Edge length was a better predictor than woodlot area. The best model for species richness had three variables and accounted for 87% of the variation. The model proved robust to annual bird census fluctuations. Breeding bird density was best predicted by the quality of habitat in the neighborhood surrounding the woodlot. The uniqueness of the urban context requires a modified approach to songbird preservation. The function and optimal structure of large regional preserves are different from those of smaller urban natural areas.

245

Gould, W.P.;
Recent forest management trends-possible effects on wildlife management.
Trans. N. Amer. Wildl. Nat. Resour. Conf. 27:368-376 1962

KEYWORDS: forest management;silviculture: intensive;cutting cycles;wildlife habitat: impacts on;management implications

ABSTRACT: The purpose of this paper is to examine some of the more recent trends in forest management and attempt to speculate in regard to their possible effects on forest wildlife management. Forest management policies and techniques will vary, of course, in their effect on species of wildlife. A practice that benefits deer for example, may or may not be beneficial to other species. Each practice would have to be evaluated on a strictly local basis. Obviously, such a complex subject can be dealt with only in general terms with perhaps a few specific examples.

246

Graham, R.;
Unevenaged management in northern Rocky Mountains.
Pp. 290-297 In: Proceedings of the National Silviculture Workshop: Silviculture for All Resources, Sacramento, California, May 11-14, 1978. USDA For. Serv. Timber Management, Wash. D.C. 1989

KEYWORDS: silvicultural systems;uneven-aged management;single tree selection;group selection;free selection;harvesting;management implications

ABSTRACT: Selection silvicultural systems uneven-aged management can be applied in the Northern Rocky Mountains. Use is limited to the management of shade-tolerant species, which are often less valuable, slower growing, and more disease prone than shade-intolerant species. Selection systems are particularly valuable in special use or sensitive areas throughout the region and on sites where even-aged systems are unsuitable. Research is being conducted on the consequences of using selection systems in the Northern Rocky Mountains.

247

Granholm, S.L.;
Effects of surface fires on birds and their habitat associations in coniferous forests of the Sierra Nevada, California.

Ph.D. Thesis, Univ. California, Davis. 137 pp. 1982

KEYWORDS: fire: surface;habitat heterogeneity;bird-habitat relationships;avian diversity;avian density;foraging guilds;principal component analysis;post-fire response;principal component analysis;coniferous forest;California USA

ABSTRACT: Before this century, surface fires were an important ecological factor in coniferous forests of the Sierra Nevada. I investigated the effects on birds of two surface fires-a prescribed fire in white fir-mixed conifer forest (Oct. 1976) and a natural fire in red fir forest (July 1976). I sampled habitat features and relative abundance of birds in the two burns and in matching unburned forests during the breeding and postbreeding seasons of 1976-8. Although habitat heterogeneity increased after both fires (in the understory), bird species richness did not increase consistently. Total relative density of birds declined in both burns. Eight bird species responded positively to one or both fires, five responded negatively, and seven exhibited mixed or no response. Only one major foraging guild, the bark-drilling insectivores, exhibited similar (positive) responses to the fires among all member species. Changes in abundance of bird species are attributed to changes in food supply, nest-site availability, and structure of understory habitat. I consider these results to be broadly applicable to surface fires in coniferous forests, given similar burn intensity and lack of shrubs. To explore the habitat associations of birds in surface-burned forests, I used principal component analysis to derive a composite based on the height of scorched foliage and percent of the ground surface burned, represented burn intensity. Correlations of bird variables with these two habitat variables in 30 m radius circulate plots suggested that most effects of the fires on birds were mediated through changes in understory structure. Bird species richness and total abundance were not strongly related to either habitat variable, but five bird species showed definite habitat associations. Heavy surface-burning had more harmful than beneficial effects on birds, but in general the surface fires had as many positive as negative impacts. In a separate section, I analyse the bias in density estimates caused by movement of birds into and out of the circular plots during the 10-min count periods. I conclude that density estimates for the three species analysed were inflated by at least 22-56%. Movement poses a similar problem for most bird-sampling methods based on counts.

248

Grue, C.E.; Shipley, B.K.
Interpreting population estimates of birds following pesticide applications-behavior of male starlings exposed to an organophosphate pesticide.
Studies in Avian Biology No. 6:292-296 1981

KEYWORDS: pesticide application;organo phosphate;starlings;post-spraying responses;avian numbers;avian behaviour;management implications

ABSTRACT: We determined activity budgets for 10 pairs of captive male Starlings between 7 May and 18 July 1980. Our objective was to quantify changes in behavior after exposure to an organophosphate (OP) pesticide and to assess the impact of changes in behavior on the interpretation of population estimates of birds following pesticide applications. We observed each pair of males for an hour at 07:30 and 09:30 for four days and classified their behavior into one of four categories: flying, perching, foraging, or singing and displaying. At 06:30 on day 2 one male received a single oral dose of 2.5 mg dicrotophos per kg of body eight; the other male received an equivalent exposure of corn oil. Changes in the activity budgets of OP dosed and control males were compared using t-tests. Activity of OP dosed males was significantly (P<=0.05) reduced within the 2-4 h following exposure. OP dosed males spent more time perching (46.1%) than controls and less time flying (-96.6%), foraging(-28.5%), and singing and displaying (-49.5). The frequency of perching (-75.3%), flying (83.8%), foraging (-54.1%), and singing and displaying (-59.2) was significantly reduced. Activity in OP dosed males returned to normal by 26-28 h posttreatment. Results suggest that movement and vocalization may be significantly reduced in birds exposed to organophosphate and carbamate pesticides. Conventional censusing techniques and population estimating procedures may, therefore, be inadequate to assess changes in bird populations after pesticide applications because of the difficulty in separating decreases in density due to mortality or emigration from reductions in activity.

249

Gruell, G.E.; Schmidt, W.C.;Arno, S.F.;Reich, W.J.
Seventy years of vegetative change in a managed Ponderosa Pine forest in western Montana-implications for resource management
USDA For. Serv., Intermtn. For. and Range Exp. Stn., Gen. Tech. Rep. INT-130 1982

KEYWORDS: managed fores;timber harvest;silviculture treatments;forest succession;wildlife habitat;management implications

ABSTRACT: *More than 100 years have passed since the initial settlement of western Montana. During this period forest vegetation has changed, but there is little documentation on the degree of changes, what brought about these changes, and the effect of these changes on forest resources and activities. This paper contains a photographic record and supporting evidence of successional changes in a ponderosa pine/Douglas-fir forest typical of western Montana. This area and comparable lands were logged (mostly partial cuts) starting as early as the 1880's. Logging, grazing, and fire suppression resulted in successional changes that differed from those that occurred in the presettlement environment. The implications of forest succession on timber management, wildlife habitat, live-stock grazing, forest fuels, and scenic quality are discussed. Content should prove useful to silviculturists, foresters, fire management officers, wildlife biologists, and others who have management responsibilities. This information should also be useful in further ecologically sound forest management.

250

Gullion, G.W.;
Maintenance of the aspen ecosystem as a primary wildlife habitat.
Proceed. XIIIth Internat'l Congr. Game Biologist. p. 256-265 1977

KEYWORDS: aspen ecosystem;wildlife habitat;forest management;management considerations

ABSTRACT: The aspen ecosystem is an important component of North American forests, occupying over 120 million hectares in the United States and Canada. This early successional ecosystem is dominated by the short-lived, shade-intolerant aspens, which have long been maintained by frequent periodic destruction of the forest, usually by fire or windstorm. Aspen has long been identified as an important habitat resource for many species of forest wildlife, but only in recent years has the dependence of several species upon aspen become recognized. Most notable is the close relationship between ruffed grouse and the aspens. Several other northern American wildlife species appear to do best in association with this ecosystem, including woodcock, wood duck, beaver, white-tailed deer, snowshoe hare, moose, timber wolf, and black bear. A number of songbirds are most closely associated with this ecosystem. Long-prevailing forest management practices threaten the maintenance of these ecosystem. Effective protection from fire is the major threat, but harvesting procedures or protection from harvesting has aggravated the problem. In eastern United States forests, more than 1.2 million ha of this ecosystem have been lost in the past 20 years, and loss through decadence or conversion to other forest types is accelerating on millions of hectares. The aspens are unusual among forest trees in that vigorous stands are maintained by killing aerial stems when they reach maturity to stimulate root suckering. Even spacing of the sucker and subsequent sapling growth provides the best cover for small wildlife species, and later the fleshy leaves and rich staminate-flower buds provide essential summer and winter-long food resources for several species of wildlife. Commercial harvest of this ecosystem can be adjusted economically to meet the needs of many wildlife species. Where this is not done, regeneration cutting to preserve these plants and the animals associated with them is becoming necessary.

251

Gullion, G.W.;
Aspen management - an opportunity for maximum integration of wood fiber and wildlife benefits.
Trans. N. Am. Wildl. and Nat. Res. Conf. 50:249-261 1985

KEYWORDS: aspen forest;aspen management;clearcutting;wildlife integration;management implications;USA

ABSTRACT: The aspen ecosystem provides the basic habitat resource for several species of North American wildlife and an important habitat for many others across a substantial part of the continent. Unlike many wildlife habitats it does not maintain itself if we simply leave it alone. Maintenance of this ecosystem as a primary wildlife habitat requires periodic and properly dispersed catastrophic destruction to stimulate regeneration. I add, commercial clear-cut logging, providing a needed raw material is the best way to reap maximum wildlife benefits while preserving the beauty of our nation's aspen resource.

252

Gullion, G.W.;
Northern forest management for wildlife.
Faculty of Agr. and For., Univ. of Alberta, Forest Ind. Lec. Ser. No. 17. 26 pp. 1986

KEYWORDS: aspen ecology;aspen forest management;habitat;bird associations;timber harvest;clearcutting:blocks/strips;forest succession;wildlife integration;management implications;Alberta

ABSTRACT: **A paper which discusses the timber and wildlife value of the aspen forests of North America. Briefly describes the ecology of the aspen forest system, suggesting that timber harvest and wildlife habitat management can work in conjunction to the benefit of both.

253

Gutierrez, R.J.;
An overview of recent research on the spotted owl.
Pp. 39-49. in: R.J. Gutierrez and B. Carey (tech. eds.). Ecology and management of the spotted owl in the Pacific Northwest. USDA For. Serv. Gen. Tech. Rept. PNW-185 1985

KEYWORDS: northern spotted owl;life history;natural history;habitat use;literature review

ABSTRACT: The recent literature on the northern spotted owl is reviewed and the salient features of the owl's natural and life history are presented. The conclusion is that northern spotted owls are dependent upon old-growth forests of the Pacific Northwest.

254

Gutierrez, R.T.; Decker, D.J.;Howard, R.A., Jr.;Lassoie, J.P.
Managing small woodlands for wildlife.
Cornell Univ., Coll. Agric. and Live Sci. Inf. Bull. 157. 32 pp 1979

KEYWORDS: small woodlots;avian ecology;avian diversity;avian succession;bird-habitat relationships;forest succession;habitat manipulation;timber management;management implications

ABSTRACT: *The future of wildlife habitat in the Northeast is in the hands of the private landowner. Therefore, the responsibility for the direct care and husbandry of the woodland wildlife belongs to the small woodland owner. Studies show that landowners care about their land for reasons beyond its economic value, but that they often lack the background information to maximize wildlife values on their lands. A few examples of how a woodland owner can enhance and maintain good wildlife habitat have been provided in this bulletin.

255

Gutierrez, R.J. and Carey, B. (tech eds), ;
Ecology and management of the spotted owl in the Pacific Northwest.
USDA For. Serv., Pacific Northwest For. and Range Exp. Stn., Gen. Tech. Rep. PNW-185. 118 pp. 1985

KEYWORDS: spotted owl;symposium;research;management

ABSTRACT: *The spotted owl, has become a species of concern to ornithologists, wildlife biologists, foresters, and environmentalists because of its apparent need for old-growth coniferous forest in the Pacific Northwest. Because of the concern about spotted owls, a symposium was convened by the Cooper Ornithological Society during its annual meeting in 1984. The symposium was organized into three sections: management, research, and theory.

This report contains those papers presented at the meeting, as well as some unpresented papers, ensuring a published report that would be a complete treatment of spotted owl research and management in the Pacific Northwest.

256

Gysel, L.W.;
An ecological study of tree cavities and ground burrows in forest stands.
J. Wildl. Manage. 25:12-20 1961

KEYWORDS: cavity-tree characteristics;old-growth forest;managed forest;unmanaged forest;logging;silviculture;cavity-nesting birds;Michigan USA

ABSTRACT: *In forested areas, cavities in trees and logs, and burrows in the ground form escape and nesting cover that may be used by many small mammals and some birds. The kind and number of these cavities and burrows may be related in part to forest type and stand condition. Objectives of this study were to determine the number and size of cavities and burrows in different forest stands, to determine environmental relationships, and to indicate the amount of animal use. Stand differences were due primarily to varying degrees of cutting and grazing.

257

Haapanen, A.;
Bird fauna of the Finnish forest in relation to forest succession. I.
Annu. Zool. Fenn. 2:153-196 1965

KEYWORDS:

ABSTRACT: not reviewed

258

Hagar, D.C.;
The interrelationships of logging, birds, and timber regeneration in the Douglas-fir region of northwestern California.
Ecology 41:116-125 1960

KEYWORDS: habitat disturbance;timber harvest;logging;post-logging response;avian ecology;avian diversity;habitat preference;Douglas-fir forest;California USA

ABSTRACT: Logging of the forest caused a definite increase in bird population size and a marked change in species composition. There was little change in total number of species at first, but an increase occurred within 3 years after cutting. The junco became predominant on cutovers where an abundance of weed seeds, berries and insects helped the population flourish. These birds turned largely to Douglas-fir seed when it became available. Other important seed eaters which invade logged areas to forage on the ground were varied thrush, spotted towhee, mountain quail, golden-crowned sparrow, and fox sparrow. Stellar jays and winter wrens also were important in the ecology of logged areas, but the former bird was not a harmful influence on regeneration. Several species of finches, the red-breasted nuthatch, and the chestnut-backed chickadee attacked the cones of seed producing trees around borders of cutovers. Many other species of birds were affected by logging.

259

Haila, U.; Jarvinen, O.;Vaisanen, R.A.
Effects of changing forest structure on long-term trends in bird population in southwest Finland.
Ornis. Scand. 11:12-22 1980

KEYWORDS: ;avian diversity;;avian succession;forest succession;forest fragmentation;bird-habitat relationships;habitat disturbance;clearcutting;migratory birds;Finland

ABSTRACT: Nine forest habitats were studied in Finland in 1926-27 and 1975. Part of the differences between the censuses may be accounted for by differences in census methods, but many changes in bird populations could be predicted on the basis of changing forest structure. Increased forest fragmentation may also have played a significant role. Other causes include mild winters preceding 1975 and changes due to new species immigrated to our insular study area. In general, non-passerines decreased, but passerines increased greatly. Species diversity increased in all habitats except one.

260

Haila, Y.;
North European land birds in forest fragments: evidence for area effects?
Pp. 315-319 in: J. Verner, M. Morrison, and C.J. Ralph, eds. Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. Univ. Wisconsin Press, Madison WI. 1986

KEYWORDS: forest fragments;minimum area requirements;area effects;edge effect;forest structure;avian ecology;model;conservation implications;Europe

ABSTRACT: I elaborate a sampling model for the colonization of habitat islands by North European land birds. The model is based on the hypothesis that different species colonize islands independently of each other and in numbers that are compatible with their regional abundances and habitat requirements. Data from several forested archipelagoes in northern Europe agree with this view. The propensity of different species to colonize is determined by the availability of suitable habitats and, in some cases, by specific autecological mechanisms; no area effects are discernible. Forest fragmentation per se is not likely to be important for forest birds in northern Europe. The challenge for conservation is to identify the indirect consequences of fragmentation, such as habitat changes and edge effect, that are important for different species. The total area of habitats important for birds is of greater concern than the spatial configuration of the habitats.

261

Hale, J.B.; Gregg, L.E.
Woodcock use of clearcut aspen areas in Wisconsin.
Wildl. Soc. Bull. 4:111-115 1976

KEYWORDS: aspen forest;woodcock populations;habitat disturbance;clearcutting;scarification;post-logging response;management implications;Wisconsin USA

ABSTRACT: Clearcut areas in northern Wisconsin aspen forest were highly attractive to woodcock for feeding and night-roosting, and made excellent sites for woodcock trapping and banding. Woodcock use of clearcuts was extended several years by annually removing vegetation from trails with a bulldozer. A continued high demand for aspen pulpwood may be important in maintaining woodcock numbers in the Great Lakes states.

262

Hall, F.C.;
Western forest types and avian management practices.
Pp. 27-37 in: R.M. DeGraaf, Tilgham, N., eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: avian ecology;bird-habitat relationships;vegetation structure;vegetation succession;edge: inherent/induced;fire: crownfire/underburn;silviculture treatment;rotation period;management implications

ABSTRACT: The species composition, structure and distributional pattern of forest vegetation directly influence wildlife species, their density, and distribution. Pristine vegetation is discussed as a baseline for evaluating management practices. Inherent vegetation composition, structure and pattern is caused by soil and topographic characteristics and differences in climate, for example, the natural pattern of different habitat types. Induced vegetation pattern is caused by disturbances such as lightning fires. Thus, induced structure is dynamic; it changes as plant succession moves from grass-forb to poles, sawtimber and old growth. Induced pattern is dynamic, changing geographically as different areas are disturbed. Wildlife species, population density, and distribution are also dynamic. Forest managers must accept that we cannot return forests to pristine conditions, that timber management will be practiced on most forest lands, that timber vegetation will change, and that inherent vegetation patterns will influence the selection of treatment to enhance wildlife. Wildlife habitat can be enhanced by modifying silvicultural treatment, modifying scheduling of treatment, and by allocating land areas to emphasize wildlife management objectives.

263

Hall, G.A.;
Population decline of neotropical migrants in an Appalachian forest.
Am. Bird 38:14-18 1984

KEYWORDS: avian ecology;avian diversity;status;migratory songbirds;clearing:tropical forest;climatic factors;Virginia USA

ABSTRACT: The data presented here indicate that both the number of species and the population of the neotropical migrants on this virgin tract have declined over the years of study. Examination of the numbers for individual species show small and often insignificant declines, but in aggregate these amount to a significant decrease. The most likely cause for the decline appears to be the removal of the tropical rainforest, and climatic and weather factors on the summer breeding areas.

264

Hall, F.C.; Thomas, J.W.
Silvicultural options.
Pp. 129-147 In: J.W. Thomas, tech. ed. Wildlife habitats in managed forests: The Blue Mountains of Oregon and Washington. USDA For. Serv. Agric. Handbook 553. 1979

KEYWORDS: habitat management;silviculture: options;stand size;stand condition;treatment scheduling;rotation systems;management implications

ABSTRACT: "It is possible to accomplish both wildlife and timber management objectives in the managed forest. This chapter has explained how that can be done for the two primary wildlife management systems-featured species management and management for species richness. Any combination of these two approaches can also be used. Silvicultural prescriptions can be used to produce wood at a high percentage of the forest's biological potential while simultaneously providing wildlife habitat. Trade-offs are mandatory, but the degree to which timber production or wildlife habitat is traded off to meet either objective depends on management goals. On public lands, these goals are prescribed by law and instituted through a required process of land-use planning. It is not a question of whether or not to produce both timber and wildlife in the managed forest-that is required by law. And it is not a question of whether both can be produced-they can. But there must be a commitment to do the job right and the necessary creative skill on the part of the forester and wildlife biologist to set objectives and make equitable trade-offs.

265

Hamilton, R.B.; Noble, R.E.
Plant succession and interactions with fauna.
Pp. 96-114 in: D.R. Smith, tech. coord. Proc. of the symposium on management of forest and range habitats for nongame birds. USDA For. Serv. Gen. Tech. Rept. WO-1. 1975

KEYWORDS: avian ecology;vegetation succession;avian succession;bird-habitat relationships;avian diversity;forest management;habitat destruction;endangered species;management implications

ABSTRACT: A literature search revealed that not much is known about bird populations in deciduous forest seres. Habitat management results in modifying, simplifying, and changing relative proportions of habitats. Avian variety and density is related to habitat type and complexity. To encourage birds by management, habitat variety and complexity should be emphasized.

266

Hardin, K.I.; Evans, K.E.
Cavity nesting bird habitat in the oak-hickory forest - a review.
USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-30. 23 pp. 1977

KEYWORDS: bibliography;cavity-nesting birds;habitat selection;habitat utilization;forest management;management implications

ABSTRACT: *The purpose of this article is to review, analyze, and integrate the published information on habitat selection and utilization of cavity-nesting birds and relate this information to forest management situations. The report: (1) covers the known aspects of the habitat selection and utilization; and (2) discusses management implications.

267

Harestad, A.S.; Keisker, D.G.
Nest tree use by primary cavity-nesting birds in south central British Columbia.
Can. J. Zool. 67:1067-1072 1989

KEYWORDS: avian ecology;cavity-nesting birds;tree preference;snags;cavity-tree characteristics;tree decay;British Columbia

ABSTRACT: Heartwood decay was the most important factor in nest tree selection by primary cavity-nesting birds in the Interior Douglas-fir Biogeoclimatic Zone of British Columbia. Of 243 active nests, most were in trembling aspen and paper birch. Douglas-fir and hybrid spruce were not used for nesting. Strong excavators preferred to nest in live trembling aspen with heartwood decay. Weak excavators preferred to nest in dead trees or dead tops of live trees. Yellow-bellied Sapsucker preferred to nest in trees larger than 30 cm diameter at breast height, and Pileated Woodpecker preferred trees larger than 40 cm diameter at breast height. No significant preference for nest tree diameter was detected for other species.

268

Hager, R.;
Managing old-growth forests as wildlife habitat: an ecosystems approach.
USDA For. Serv. Northern Region, Missoula, MT. 50 p. 1978

KEYWORDS:

ABSTRACT:

269

Harlow, R.F.; Gaynn, D.C., Jr.
Snag densities in managed stands of the South Carolina Coastal Plain.
South. J. Appl. For. 7:224-229 1983

KEYWORDS:

ABSTRACT: not reviewed

270

Harris, J.;
Wildlife on managed forested lands.
Pp. 209-221. in: J. O'Loughlin and R.D. Pfister, eds. Management of second-growth forests the state of knowledge and research needs. Proc. of Symp. held May 14, 1982 in Missoula, Montana. 1983

KEYWORDS: avian ecology;forest management;wildlife management;forest succession;even-aged management;uneven-aged management;silviculture;logging;down wood;fire;riparian forest;management implications

ABSTRACT: *This paper reviews the available literature on the relationship between forest management and wildlife management and the impacts of potential forest management on wildlife and wildlife habitat. Forest management practices do affect wildlife. Manipulation of the forest environment can be detrimental to some species and beneficial to others. Methodologies to assess these impacts accurately and to predict the response of most wildlife species to plant community changes are non-existent, incomplete or poorly documented. Wildlife managers need to know more about the specific habitat requirements of wildlife in order to protect and manage it. Integration of timber harvesting and wildlife management is possible if one is willing to plan ahead, use data creatively, consider the various options and accept the trade-offs. Some preliminary forest/wildlife habitat management guidelines are discussed and two examples of specific wildlife habitat management prescriptions are given. A number of research needs are suggested.

271
Harris, L.D.; Bowman, G.B.;McElveen, J.D.;Miller, R.I.;Trupe, S.
Effects of forest management practices on wildlife ecology: a list of citations.
USDA For. Serv., IMPAC Reports, Vol. 3, No. 9. 108 p. 1978

KEYWORDS: bibliography;forest management;wildlife ecology

ABSTRACT: **A bibliography of the effects of forest management practices on wildlife ecology, including some references on nongame birds.

272
Harris, L.D.; Maser, C.;McKee, A.
Patterns of old growth harvest and implications for Cascades wildlife.
Trans. N. Am. Wildl. and Nat. Res. Council. 47:374-392 1982

KEYWORDS: old-growth;harvesting trends;cutting patterns;forest fragmentation;forest succession;wildlife consequences;management implications;Oregon USA

ABSTRACT: Perceptions of the significance of old-growth harvesting in western Oregon and western Washington have been quite recent. While there has been a modest 5% reduction in commercial forest acreage, the reduction in softwood net volume, softwood sawtimber, and large diameter sawtimber has been 18%, 21%, and 34%, respectively. Cutting predominated on low elevation sites during early decades but has since shifted to predominantly high elevation sites. Approximately 25% of the Willamette N.F. remains in old-growth. The largest old growth Douglas-fir stand remaining in the Siuslaw N.F. is less than 1000 acres (400 ha); the median size is 31 acres (12.5 ha), and the mean is 68 acres (27.6 ha). Vertebrate species diversity declines inversely with elevation and yet most old growth set aside areas occur at high elevations. Vertebrate species diversity is high in very early and very late stages of the Douglas-fir successional sequence. This suggests that an inter-dependent system of clearcuts and old growth stands should be interspersed throughout the managed forest. We believe habitat island size should be treated as a variable rather than a constant. Recommended size is inverse to the degree the stand is exposed to clearcuts and young stands. Long rotation management islands that buffer the old-growth stands will minimize the old growth acreage required as set-asides.

273
Hassinger, J.D.; Liscinsky, S.A.;Shaw, S.P.
Clearcutting in Pennsylvania. Chapter 6. Wildlife.
In: Clearcutting in Pennsylvania School of Forest Resources - College of Agriculture, The Pennsylvania State University. 81 p 1975

KEYWORDS: clearcutting;forest succession;forest diversity;wildlife-habitat relationships;wildlife: impacts on;mitigation measures;management recommendations;Pennsylvania USA

ABSTRACT: *The net worth of a clearcut to wildlife must be viewed as a balance of values, as processes detrimental to one species may well benefit another. This chapter deals with the nature, extent, and management implications of these processes as they affect wildlife in Pennsylvania's deciduous forests.

274

Haws, K.;
Owl management techniques.
Pp. 302-303 in: R.W. Nero, R. J. Clark, R.J. Knapton, and R.H. Hamre, eds. Biology and conservation of northern forest owls, symposium proceedings. USDA For. Serv. Gen. Tech. Rept. RM-142 1987

KEYWORDS: owl management;management programs;overview

ABSTRACT: *Wildlife management issues and programs involving northern owls were the subject of this workshop. Programs currently underway in various parts of the United States and Europe were summarized by the panelists. Currently, management programs involve habitat preservation, placement of nest structures, protection of nest trees, education efforts, old growth forest protection and initiation of an ecosystem approach to habitat management.

275

Heard, J.L.;
Utilization of three age classes of pine monoculture by eastern bluebirds in North Carolina.
M.S. Thesis. N.C. State Univ., Raleigh. 35 pp. 1979

KEYWORDS:

ABSTRACT: not reviewed

276

Heinselman, M.L.;
Fire in the virgin forests of the Boundary Waters Canoe Area, Minnesota.
Quat. Research 3:329-382 1973

KEYWORDS: fire: wild;fire: prevention;forest succession;avian fauna;habitat selection;fire adaptation

ABSTRACT: Fire largely determined the composition and structure of the presettlement vegetation of the Boundary Waters Canoe Area as well as the vegetation mosaic on the landscape and the habitat patterns for wildlife. It also influenced nutrient cycles, and energy pathways, and helped maintain the diversity, productivity, and long-term stability of the ecosystem. Thus the whole ecosystem was fire-dependent. A Natural Fire Rotation of about 100 yr prevailed in presettlement times, but many red and white pine stands remained largely intact for 150-350 yr, and some jack pine and aspen-birch forests probably burned at intervals of 50 yr or less. There is paleoecological evidence that fire was an ecosystem factor before European man arrived, and even before early man migrated to North America. Probably few areas ever attained the postulated fir-spruce-cedar-birch climax in postglacial times. To understand the dynamics of fire-dependent ecosystems fire must be studied as an integral part of the system. The search for stable communities that might develop without fire is futile and avoids the real challenge of understanding nature on her own terms. To restore the natural ecosystem of the Canoe Area, fire should soon be reintroduced through a program of prescribed fires and monitored lightning fires. Failing this, major unnatural, perhaps unpredictable, changes in the ecosystem will occur.

277

84

Helle, P.;
Effects of forest regeneration on the structure of bird communities in northern Finland.
Holarctic Ecology. 8:120-132 1985

KEYWORDS: avian ecology;avian diversity;avian biomass;avian community structure;nesting-substrates;migratory status;forest regeneration;bird-habitat relationships;forest structure;Finland

ABSTRACT: Breeding bird communities in five stages of secondary forest succession were studied in northeastern Finland in 1980-1982. Three groups of communities were distinguished: open land, brush phase, and forest communities. Pair density, number of species, biomass of adult birds and species diversity increased in the course of succession, none of these, however, monotonously. Average bird weight showed a decreasing trend although the variation was considerable. The degree of specialization in communities increased in the course of succession with the exception that the initial stage had relatively high values. Species nesting and feeding in trees and shrubs increased in numbers during forest regeneration whereas species nesting and feeding on the ground showed the opposite trend. The proportions of hole-nesting and sedentary species increased with increasing forest age.

278

Helle, P.;
Conifer bird communities in Finland: Habitat utilization and role division in mature and successional phases
Proc. 19 Int. Ornithol. Congress., Ottawa. 1987

KEYWORDS: avian communities;migratory status;avian diversity;boreal forest;bird-habitat relationships;clearcutting;forest succession;Europe

ABSTRACT: In northern Finland, openness of vegetation was the most important factor affecting habitat selection in breeding-bird communities. The density, species diversity, and proportion of sedentary species showed no consistent differences between a "stable" open peatland and rapidly changing clear-cut (both treeless habitats) and between a "stable" pine bog and successional seedling stand (vegetation height about 5 m). The general appearance of a habitat appears to be more important than its history. Northern clear-cuts remain fairly open for 10-20 yr after felling because of the slow plant growth rate, and their bird communities are typical of open bogs. In southern Europe, plant succession after cutting is so rapid that clearcuts are suitable for open-habitat species for a much shorter period. The percentage of tropical migrant passerines is highest in young successional stages in Europe, but in forest proper in North America. Habitat availability in wintering quarters determines their breeding distribution in northern breeding areas.

279

Helle, P.; Fuller, R.J.
Migrant passerine birds in European forest successions in relation to vegetation height and geographical position.
J. An. Ecol. 57:565-570 1988

KEYWORDS: avian ecology;migratory birds;songbirds;bird-habitat relationships;forest succession;forest structure;Europe

ABSTRACT: The proportion of pairs of known trans-Saharan migrant species in the breeding population of passerine birds was examined in relation to vegetation height, geographical position and climate in twenty European studies of forest succession. The proportion of migrant pairs was consistently low in the tallest vegetation , highest in vegetation 1-2 m high, and higher in northern and central Europe, than in southern and western Europe, respectively. Using stepwise regression analysis, vegetation height and longitude were found to be the best predictors of the proportion of migrants; this was the case for the complete data set and for coniferous successions which were analysed separately. The breeding densities of trans-Saharan migrants were greatest in the middle stages of succession at a vegetation height of 1-10 m. Five main groups of migrant assemblages were identified in terms of successional stages and region; early successional stages supported distinct assemblages from the later stages with those in southern Europe being strikingly different to all others. Diversity of migrant assemblages was lowest in western Europe and it tended to be lower in late than in early successional stages. In western and southern Europe the diversity of migrant assemblages was greatest where migrants were abundant relative to other species, but this did not appear to be the case in northern and central Europe.

280

Herrera, C.M.;
On the breeding distribution pattern of European migrant birds: MacArther's theme reexamined.
Auk 95:496-509 1978

KEYWORDS: avian ecology;biogeography;migratory birds;breeding distributions;habitat selection;Europe

ABSTRACT: There is a conspicuous gradient in the proportion of passerine breeding communities contributed by tropical migrants (PPM) in Europe, with communities located in the northernmost areas showing the greatest percentages and those located to the south the smallest. To explain the European pattern of PPM, I suggest that the percentage of migrants in a community during the breeding season depends on both the harshness of adverse winter conditions faced by the resident populations and on the total resource availability during the breeding period. Carrying capacity of the habitat during the severe season will to some extent regulate the size of resident populations in the following breeding period, which in turn must affect the abundance of migrants that may successfully colonize the habitat. Very harsh winters coupled to very productive breeding seasons favor the largest percentage of migrants.

281

Herrera, C.M.;
Ecological correlates of residence and non-residence in a Mediterranean passerine bird community.
J. Anim. Ecol. 47:871-890 1978

KEYWORDS: avian ecology;avian diversity;avian communities;migratory status;foraging behaviour;habitat seasonality;Spain

ABSTRACT: A southern Spanish passerine bird community was studied throughout a year, making comparisons of behavioural, morphological and feeding site niche characteristics between resident and non-resident species. For all species, within-species foraging diversity is significantly greater for non-resident than for resident species. Resident species are morphologically more diversified and less densely packed in the morphological space than non-resident ones. Resident species exhibited feeding site niche shifts in response to its own population density, higher densities promoting wider niches as theoretically expected. Non-residents did not show comparable shifts. A canonical correlation analysis was able to show that resident and non-resident species adjust themselves to the changing environment in different ways. Whereas residents do it by means of changes in density, niche breadth and between-species foraging diversity, non-residents species achieve the same end by means of changes in morphological specialization, behavioural specialization and diversity of foraging tactics, all of which take place through seasonal replacement of species. The seasonal organization of the study community is discussed in relation to other temperate and non-temperate communities.

282

Hicks, L.L.;
Snag management: options and incentives for private landowners.
Pp. 60-63 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: snag management;snag retention;private land;economics;nest-boxes;management implications

ABSTRACT: Existing and needed incentives for snag management on private lands are discussed. Realistic management objectives must identify areas where habitat can be continuously supplied for minimum viable populations using cost effective methods. The economic and biological feasibility of some options are discussed. Until further incentives are developed, reasonable options include snag retention in riparian zones and limited-use areas, recognition of priority tree species and road management to reduce snag loss to firewood cutters.

Hilden, O; 283
Habitat selection in birds: A review.
Ann. Zool. Fenn. 2:53-75 1965

KEYWORDS:

ABSTRACT: not reviewed

Holling, C.S.; 284
Temperate forest insect outbreaks, tropical deforestation and migratory birds.
Memoirs of the Ent. Soc. Canada No. 146:21-32 1988

KEYWORDS: avian ecology;migratory birds;deforestation:tropical;forest insect outbreaks;budworms;bird-insect relationships

ABSTRACT: Ecosystems that are managed for resource production are under continual structural change. Changes imposed by local management aggregate to produce regional patterns and new regionwide responses. Anthropogenic influences on hemispheric and global processes add another level of change. The result is a bewildering variety of real or anticipated changes unique to experience. For example, in the spruce/fir and budworm interaction of eastern North America, a syndrome of causes affects the vulnerability of renewable resources, and the triggers of change can never be predicted. Yet, it is possible to identify key features that affect resilience of ecosystems and robustness of regulation and to reject other possibilities. This approach provides a way to assign priorities for research and for contingency planning to adapt to change.

Holmes, R.T.; Robinson, S.K. 285
Tree species preferences of foraging insectivorous birds in a northern hardwoods forest.
Oecologia 48: 31-35. 1981

KEYWORDS: bird-habitat relationships;forest structure;avian communities;avian density;foraging behaviour;management implications;hardwood forest;New Hampshire USA

ABSTRACT: Birds searching for insects in the canopy of a northern hardwoods forest depart significantly from random in their use of tree species, even when these trees are generally similar in life form. All 10 foliage-dwelling bird species in the Hubbard Brook forest showed preferences for Yellow Birch, most had an aversion to Beech and Sugar Maple, and a few had special preferences for conifers or White Ash. Birds that glean prey from leaves had stronger tree species preferences than those that often hover for their prey, and were more influenced by tree species differences in foliage structure. The less common bird species and those for which northern hardwoods are marginal habitat had the most pronounced tree-species preferences. Food densities which are higher on Yellow Birch and specific adaptations to foraging in trees with particular foliage structures are considered major factors responsible for the observed tree species preferences. The implications of these findings for bird community structure and for forest management practices are discussed.

Holt, D.W.; Hillis, J.M. 286
Current status and habitat associations of forest owls in western Montana.
Pp. 281-288. in: R.W. Nero, R.J. Clark, R.J. Knapton, and R.H. Hamre, eds. Biology and conservation of northern forest owls, symposium proceedings. USDA For. Serv. Gen. Tech. Rept. RM-142. 309 p 1987

KEYWORDS: forest owls;status;habitat associations;habitat management;indicator species;artificial nest sites;Montana

ABSTRACT: Nine species of owls nest in the forests of western Montana. Except for the Great Horned Owl, little is known about the other species. Only one Flammulated Owl nest has been reported in Montana. Western Screech Owls are mostly associated with riparian zones. Barred and Great Gray Owl nest site information is minimal. Boreal Owls are believed to be associated with old-growth spruce/fir forests above 1,500 m elevation. Nesting Saw-whet Owls seem to be associated with old, large, ponderosa pine snags. There is currently little data available for resource managers to make sound land-use decisions. Surveys must be established to gain basic habitat preference information for the species group.

287

Hooper, R.G.;
The influence of habitat disturbances on bird populations.
M.S. Thesis., Virginia Polytechnic Inst. 1967

KEYWORDS:

ABSTRACT: not reviewed

288

Hooper, R.G.;
Cove forests: bird communities and management options.
Pp. 90-97 in: R.M. DeGraaf, tech. coord. Proc. of the Workshop: management of southern forests for nongame birds. Jan 24-26, 1978, Atlanta, Georgia. 1978

KEYWORDS: cove forests;avian ecology;avian communities;timber management;silviculture;clearcutting;group selection;single tree selection;thinning;rotation age;management implications;USA

ABSTRACT: Over 60 species of birds regularly nest in cove forests. A primary goal for managing nongame birds is to provide suitable habitat, at some stage of the rotation, for each species that naturally occurs in a forest type. Even-aged stands up to 25 acres and rotations of 100 years should meet that goal in come forests. Commercial thinnings benefit shrub nesting species but remove potential sites for cavity nesters.

289

Hooper, R.G.; Crawford, H.S.
Woodland habitat research for nongame birds.
Trans. N. Am. Wildl. and Nat. Res. Conf. 34:201-207 1969

KEYWORDS: nongame birds;habitat analysis;research;land use impact studies

ABSTRACT: Little work has been done to determine the effect of habitat modification upon species of wildlife. This paper illustrates two approaches to habitat research of nongame bird species presently being conducted by the Southeastern Forest Experiment Station, and describes our plan of work for the future. Current needs point to increased bird-habitat research.

290

Hooper, R.G.; Crawford, H.S.;Harlow, R.F.
Bird density and diversity as related to vegetation in forest recreational areas.
J. For. 71:766-769 1973

KEYWORDS: avian ecology;avian density;avian diversity breeding birds;breeding birds;bird-habitat relationships;forest recreation;management implications;Virginia USA

ABSTRACT: Forty-nine species of birds were found nesting in 30 forest recreational areas in the Southern Appalachians. The percentage of cover provided by foliage less than 12 feet high accounted for 56 percent of the variation in densities of nesting birds. The mixture of coniferous and deciduous foliage more than 12 feet high accounted for 66 percent of the variation in the diversity of birds. Clumping of understory shrubs is important to birds in open, parklike recreational areas. Recommendations for managing forest recreational areas for reasonably dense and diverse bird populations are compatible with major management goals.

291

Hooven, E.F.;
The influence of forest succession on population of small animals in western Oregon.
Pp. 30-34. in: H.C. Black, ed. Wildlife and forest management in the Pacific Northwest. Oregon State Univ., Sch. For., For Res. Lab., Corvallis. 1969

KEYWORDS: forest succession;logging;clearcutting;fire: wildfire/prescribed;avian ecology;migratory birds;post-logging responses;post-fire responses

ABSTRACT: I review, here, the influence on populations of small animals of logging, wildfire, and other factors that create abrupt vegetational changes. Studies at two locations in western Oregon demonstrated marked changes in composition and abundance of populations of small mammals after logging and wildfire. Small mammals were more abundant in a recently logged area than in a mature stand of Douglas-fir (generic names of plants and animals are in a checklist at the end of this article). Wildfire selectively reduced populations of small mammals, but recovery, particularly of deermice, was rapid. This recovery primarily resulted from a reinvasion by the animals of habitat made favorable by the fire. The succession of important species of small mammals and seed-eating birds is related to vegetative succession and other changes in habitat. Changes in vegetative succession favor an increase on abundance and number of species of animals.

292

Hopkins, R.B.; Cassel, J.F.;Bjugstad, A.J.
Relationships between breeding birds and vegetation in four woodland types of the Little Missouri National Grasslands.
USDA For. Serv. Rocky Mtn. For. Exp. Stn. Res. Pap. RM-270. 12 p. 1986

KEYWORDS: avian ecology;avian diversity;avian community structure;bird-habitat relationships;forest structure;forest size;coniferous forests;deciduous forests;management implications;North Dakota USA

ABSTRACT: Bird species richness was greater in the cottonwood woodland type than in the juniper, pine, and ash woodland types. Total breeding bird densities were greatest in the green ash woodland type. The densities of 25 bird species were significantly different among the four woodland types. The densities of birds in five foraging guilds and four nesting guilds were significantly different among the four woodland types. The influence of vegetation on bird community structure is discussed and suggestions are made for preserving and reestablishing woodlands threatened by the strip-mining of lignite coal.

293

Horton, S.P.; Mannan, R.W.
Effects of prescribed fire on snags and cavity-nesting birds in southeastern Arizona pine forests.
Wildl. Soc. Bull. 16:37-44 1988

KEYWORDS: avian ecology;cavity-nesting birds;avian densities;prescribed burns;post-fire responses;snags;snag characteristics;management implications;Arizona USA

ABSTRACT: A single application of moderately intense surface fire in 3 pine stands in southeastern Arizona burned nearly half of all ponderosa pine snags > 15 cm dbh. Snags most susceptible to burning were those with large amounts of loose, relatively undecayed, woody debris at their bases (ie., large snags in the middle stages of decay). Few large trees were killed immediately by the fires; thus, a 45% net decrease in snags > 15 cm dbh occurred in the first year after treatment. Short-term impacts of the fires on cavity-nesting birds were minimal, despite a 33% decrease in the density of snags preferred for nesting. No species of cavity-nesting birds disappeared in the first breeding season after the fires, and only the northern flicker and violet-green swallow appeared to have declined in abundance, relative to their abundance on control stands. We do not believe that these changes were due to a shortage of nest sites.

294

Horvath, O.;
Contributions to nesting ecology of forest birds.
M.S. Thesis. Dept. Zoology and FAculty of Forestry, Univ. B.C. 181 pp 1963

KEYWORDS:

ABSTRACT: not reviewed

295

Howe, R.W.;
Local dynamics of bird assemblages in small forest habitat islands in Australia and North America.
Ecology: 65:1585-1601 1984

KEYWORDS: avian ecology;avian communities: dynamics;distribution patterns;forest fragmentation;migratory status;;forest structure;forest insularization;ecological implications;Australia;North America

ABSTRACT: Small isolated forest patches (0.1-7 ha) in eastern New South Wales and southern Wisconsin were surveyed regularly for at least 1 yr between 1977 and 1981. Forests and woodlands in both regions have been cleared extensively during the past century. This analysis examines how fragmentation of forest habitat has affected composition and dynamics of local bird assemblages. Species in forest islands are compared with those in equivalent "control plots" near the edge of a large, continuous forest. Disruption of continuous tracts apparently affects not only birds of the forest interior, but also those occurring along or near the edge. Differences between species assemblages of forest islands and control plots were most pronounced in Wisconsin. Numbers of forest or forest edge species were much lower in Wisconsin forest islands than in corresponding control plots. Isolation of forest islands was associated negatively with species richness only in Wisconsin. Long-term effects of forest fragmentation in New South Wales might not yet be realized, because relatively large areas of forest remain near existing habitat islands.

296

Hudson, R.H.; Tucker, R.K.;Haegele, M.A.
Handbook of toxicity of pesticides to wildlife.
US Dept. Int., Fish and Wildl. Serv., Resource Publication 153. 90 p. 1984

KEYWORDS: pesticides;wildlife;toxicity

ABSTRACT: *The chemicals chosen for testing included 181 pesticides, 15 other environmental pollutants, and many mixtures and formulations of pesticides. Generally, the pesticide pollutants were those to which wildlife are most likely to be exposed. Most are widely used or represent common families of chemicals used in thousands of pesticide formulations applied to forests, rangeland, aquatic habitat, or agricultural areas lived in or frequented by wildlife. Acute toxicity data and a list of the clinical signs of intoxication observed are presented for each pollutant. For some, particularly those that are likely to be applied repeatedly or to persist for a long time after single application, the results of 30-day repeated oral toxicity or feeding tests are included. Some of the pollutants were also tested for percutaneous toxicity.

297

Hungerford, K.E.;
Influence of forest management on wildlife
Pp. 39-41. In: H.C. Black, ed. Wildlife and forest management in the Pacific Northwest. Oregon State Univ.,

Sch. For., For. Res Lab., Corvalis. 1969

KEYWORDS: forest management;wildlife populations;clearcutting;silviculture;slash disposal;site preperation;herbicides;fertilization;thinning;management implications

ABSTRACT: In this paper, I examine the effects of forest management practices on wildlife populations. The impact of clearcutting in large blocks and the effects of modification of the pattern and size of clearcuttings on wildlife are described. The effects of such regeneration practices as slash disposal, site preparation, herbicide application, and fertilization on animal populations are mentioned. Experiments with thinnings in coniferous stands in northern Idaho are discussed, with reference to their effects on production of food for wildlife. The investigation of microenvironments in relation to wildlife is described as the most promising approach to ecologic controls. Investigation of microclimatic changes after stand manipulation demonstrated that the pattern of dew deposition may be modified. The significance of changes in dew accumulation in habitats of ruffed grouse in northern Idaho is reported. The conclusion is that intensive management of the forest increases opportunities for improvement of wildlife habitat, and that research on the microenvironmental effects of clearcutting in small blocks is needed.

298

Hunter, M.L. Jr.;
The indirect effects of carbaryl on the behavior of birds
Pp. 169-191 In: Maine For. Serv. Environ. Monitoring Reports from the 1980 Maine Cooperative Spruce Budworm Suppression Project. Main Dept. Conserv., August. 1981

KEYWORDS: chemical control;carbaryl;indirect effects;avian behaviour;foraging area;foraging niche selection

ABSTRACT: Because carbaryl kills large numbers of arthropods in both aquatic and terrestrial habitats its use in budworm suppression programs has a measurable effect on insectivorous birds. The foraging area and foraging niche selection of warblers and feeding behaviour of ducklings were distinctly changed by spraying. Possible effects on weight gain of chickadees and ducklings were also noted but remain inconclusive.

299

Hunter, M.L. Jr.;
The diversity of New England forest ecosystems.
Pp. 35-47 in: J.A. Bissonette, ed. Is good forestry good wildlife management? Proc. of a Joint Conference, March 6-8, 1985, Portland, Maine. 1986

KEYWORDS: forest management;economics;habitat diversity;wildlife diversity;old-growth forests;management implications;New England, USA

ABSTRACT: New England forests are very diverse, but their temporal and spatial diversity could be enhanced, and this would result in greater wildlife diversity. Sustained yield forestry has produced a reasonably balanced age class distribution with one exception: old growth forests are grossly underrepresented. To partly rectify this, 5 to 10 large examples of each of New England's forest types should be permanently set aside in a forest reserve system. Spatial variability can be enhanced by diversifying the scales at which forests are managed. Uneven-aged management through selective cutting, and even aged management through patch cutting and large scale clearcutting, can all be integrated to create a mosaic of forest structures on the landscape if a broad perspective on forest management is adopted.

300

Hutchison, F.T.;
The effects of woodpecker on the Engelmann spruce beetle, Dendroctonus engelmanni Hopkins.
M.S. Thesis. Colo. A&M Coll., Fort Collins. 73 pp. 1951

KEYWORDS:

ABSTRACT: not reviewed

301

Jacknian, S.M.;
Woodpeckers of the Pacific Northwest; their characteristics and their role in the forests.
M.S. Thesis, Oreg. State Univ., Corvallis. 147 p. 1974

KEYWORDS:

ABSTRACT: not reviewed

302

Jackson, J.A.;
A quantitative study of the foraging ecology of downy woodpeckers.
Ecology 51:318-323 1970

KEYWORDS: downy woodpecker;foraging behaviour;tree site selection;resource partitioning;intersexual variation

ABSTRACT: Studies of the foraging ecology of Downy Woodpeckers at the University of Kansas Natural History Reservation indicate that there is intersexual partitioning of the foraging niche, seasonal variation in the relative frequency of the modes of foraging, variation in the mode of foraging on live vs dead trees, and seasonal variation in the use of live and dead trees. Partitioning of the foraging niche by the sexes is accomplished behaviorally by a differential use of the available substratum according to limb height and diameter. The degree to which these unisexual subniches are expressed varies on live versus dead trees. Males tend to forage on small branches, generally 5 cm in diameter or less; females tend to forage on the trunk and larger limbs. The mean foraging height of males in live trees (6.0 m) is significantly different from that of males in dead trees (8.9 m); the mean foraging height of females in dead trees (8.4 m) is not significantly different from that of females in live trees (8.1 m) or of males in dead trees. The mean foraging height of males in live trees is significantly different from that of females in live trees. A similar relationship exists among the heights of the trees in which Downy Woodpeckers forage. Both male and female Downy Woodpeckers use sub-surface foraging techniques to a greater extent during the winter and superficial techniques during the warmer months. Greater use of dead trees during the winter is also indicated. Dead American elms are used as foraging sites by both sexes to a greater extent than expected by chance. Some other tree species seem to be favored and some avoided by one or both sexes.

303

Jackson, J.A.;
Red-cockaded woodpeckers and pine red-heart disease.
Auk 94:160-163 1977

KEYWORDS: red-cockaded woodpeckers;pine red heart disease;cavity tree selection;management implications;Mississippi USA

ABSTRACT: *The purpose of this paper is to present date on the incidence of red heart in red-cockaded woodpecker cavity trees and to clarify the relationship of the disease to tree use by the birds.

304

Jackson, J.A.; Jackson, D.J.J.
Why do red-cockaded woodpeckers need old trees?
Wildl. Soc. Bull. 14:318-322 1986

KEYWORDS: avian ecology;cavity-nesting birds;red-cockaded woodpeckers;cavity trees: age;foraging behavior;management implications

ABSTRACT:

305

Jackson, J.A.; Lennartz, M.K.;Hooper, R.G.
Tree age and cavity initiation by red-cockaded woodpeckers.
J. For 77:102-103 1979

KEYWORDS: avian ecology;cavity-nesting birds;red-cockaded woodpecker;cavity tree characteristics;tree preference;rotation period;management implications;South Carolina USA

ABSTRACT: The red-cockaded woodpecker is an endangered species that has declined in numbers with loss of nesting habitat. This loss is due partly to the increased prevalence of short rotations in southern pine forests. Data from Mississippi and South Carolina indicate that, for cavity initiation, the species needs living trees averaging approximately 75 years old for loblolly pine, and 95 years old for longleaf pine.

306

James, F.C.;
Ordinations of habitat relationships among breeding birds.
Wilson Bulletin 83:215-236 1971

KEYWORDS: avian ecology;avian diversity;breeding birds;bird-habitat relationships;forest structure;principal component analysis

ABSTRACT: Quantitative vegetational data obtained in the breeding territories of 46 species of birds are organized by species as samples of the characteristic life form of the vegetation for each. Examples of outline drawings of the niche-gestalt represent those structural features of the vegetation that were consistently present where a certain species occurred. Principal components and discriminant functions are used to describe habitat relationships among the species as positions along one-, two-, and three-dimensional continua representing gradients in the structure of the vegetation. Although all 15 vegetational variables contributed significantly to the ordinations, the most powerful variables for describing habitat differences were percent canopy cover, canopy height, and the number of species of trees pre unit area. If one considers the vegetation of a geographic area to be a set of continuously-varying phenomena, and if one assumes that bird distribution is at least partly based on species-specific adaptiveness to the resources offered by this heterogeneous structure, then ordination procedures are appropriate methods for its expression.

307

James, F.C.;
On understanding quantitative surveys of the vegetation.
Am. Birds 32:18-21 1978

KEYWORDS: habitat assessment;vegetation survey;forest structure

ABSTRACT: This paper discusses the use of a vegetative sampling method which permits a description of the trees by species and by size class in terms of their "density", "basal area" and "frequency". The method is proposed as a standard quantitative means of describing vegetation in bird census areas.

308

James, F.C.; Rathbun, S.
Rarefaction, relative abundance, and diversity of avian communities.
Auk 98:785-800 1981

KEYWORDS: avian diversity;diversity indices;relative abundance;rarefaction;bird-habitat relationships;ecological implications;Canada;USA

ABSTRACT: For 37 Breeding Bird Census taken in various terrestrial habitats across the United States and Canada, the proposed methods (rarefaction, relative abundance and diversity indices) reveal some very general relationships about the organization of bird communities in different habitats. Equal sized areas of mature deciduous forest and second-growth habitats may be equally species rich; the density of individuals is generally higher in deciduous forest habitats, and the relative abundance of bird species shows more dominance in the deciduous forest. Mixed coniferous-deciduous forests and dense young deciduous forests have fewer species than mature eastern deciduous forests or second-growth habitats, although the density of individuals is approximately equal to that in second-growth habitats. Coniferous forests are species-poor, and the density of birds is low. Although the proposed methods require assumptions that need to be evaluated carefully, we are optimistic that they will have other useful applications in the analysis of avian communities.

309

James, F.C.; Shugart, H.H. Jr.
A quantitative method of habitat description.
Am. Birds 24: 727-736. 1970

KEYWORDS: forest structure;forest diversity;habitat assessment

ABSTRACT: *We think that the usefulness of the Breeding-Bird Census and the Winter Bird-Population Study would be increased greatly if observations would provide accompanying quantitative data on the structure of the vegetation. By sampling five or more tenth acre circular plot this information can be obtained with a maximum of accuracy and a minimum of effort. Additional word descriptions of the physiognomy of the area and other non-botanical features will still be valuable.

310

James, F.C.; Wamer, N.O.
Relationships between temperate forest bird communities and vegetation structure.
Ecology 63:159-171 19d2

KEYWORDS: avian ecology;avian communities;avian diversity;forest structure;bird-habitat relationships;temperate forests;rarefaction;principal component analysis;ecological implications;North America

ABSTRACT: General patterns of density, species richness, and relative abundance of breeding birds are examined in a wide variety of North American forests. Taking data from censuses published in American Birds, we use rarefaction to ordinate the species richness of communities in terms of samples of equal numbers of individuals. By this criterion young forests in secondary succession and mature deciduous forests can be equally rich in bird species; coniferous forests and dense successional stands having only one or two species of trees have the fewest species of birds. For our data set the density of birds is higher in mature deciduous forests than in successional stands. The species/area relationship (s/a) is a function of both this species/individuals relationship (s/n) and the individuals/area relationship (n/a). S/a shows maximal values in mature deciduous forests, but not in those that have the highest tree species richness, canopy height, or tree density. The n/a values show a similar pattern except that maximal density occurs at maximal values of tree species richness and canopy height. By this criterion both species richness and density are minimal in coniferous forests characterized by high tree density, low canopy, and few species of trees. These patterns are not discernible by the classic bird species diversity/foliage height diversity methods. We recommend rarefaction, principal component analysis, and contour diagrams to display relationships among communities.

311

Janik, C.A.;
The nesting biology and behavior of woodland raptors in western Maryland.
M.S. Thesis. Frostbury State College, Frostbury, Md. 88 pp 1980

KEYWORDS:

ABSTRACT: not reviewed

312

Jardine, D.C. ed.;
Wildlife management in forests.
Proceedings of a discussion meeting, Univ. Lancaster, 3-5 April 1987, Edinburgh, UK. Instit. of Chartered Foresters. 1988

KEYWORDS:

ABSTRACT: not reviewed

313

Johnson, A.S.; Landers, J.L.
Habitat relationships of summer resident birds in slash pine flatwoods.
J. Wildl. Manage. 46:416-428 1982

KEYWORDS: avian ecology;avian diversity;avian density;songbirds;bird-habitat relationships;timber management;silviculture;plantations;fire;forest regeneration;pine:slash;Georgia USA

ABSTRACT: Resident songbirds in slash pine stands in southeastern Georgia were related to forest regeneration method, stand age, and fire history and compared to those in timber types of mixed composition. In fallow areas and young plantations, bird community composition changed predictably with the structure of the vegetation. Abundance and diversity were related to residual trees and snags providing habitats for hole- and canopy-feeders. Bird numbers and diversity generally were lowest in 1-year-old plantations, temporarily recovered in plantations 2-6 years old, then declined again until about midrotation. In pine stands past midrotation (16-28 years), bird communities were unaffected by origin of the stand (site-prepared and planted or naturally regenerated), stand age, or years since burning. The understory in burned pine stands on flatwoods soils consists mainly of a single stratum of low-growing shrubs that rapidly recover from burning, and birds showed no detectable responses to fire on a 5-year frequency. The bird community, dominated by canopy-feeders and ground-feeding insectivores, was poorly correlated with measurements of stand density, understory characteristics, and fruit availability. Wet sites with mixed hardwoods supported 17 species that were absent or rare in the pine type, and were important in maintaining bird diversity.

314

Johnson, H.J.; Cerezke, H.F.;Endean, F.;Hillman, G.R.;Kiil, A.D.;Lees, J.C.;Loman, A.A.;Powell,
Some implications of large-scale clear-cutting in Alberta-a literature review.
Can. Forestry Serv., Northern For. Res. Centre, Edmonton, Alta. Info. Rep. NOR-X-6. 114 p 1971

KEYWORDS:

ABSTRACT: The plans for pulpmill establishment and expansion in Alberta and the rapid change to close utilization and mechanized logging has prompted concern over the ecological effects of clearcutting large blocks of timber in the order of hundreds or thousands of acres. This review and interpretation of literature was conducted at the request of the Alberta Department of Lands and Forests and will serve as a basis for research programming as well as forest management planning. Controversy over clearcutting is gathering momentum in the United States and parts of Canada and is described by Shaw in a report to the United States Congress as "one small facet of the crusade to save the environment". It is essential that Alberta foresters be prepared for greater public interest in renewable resource management and united in their defence of sound forestry practices which are consistent with the needs of the people. This review considers most of the available information regarding the effects of clearcutting on climate, hydrology, stand establishment and protection from fire, disease and insects. Unfortunately important aspects such as recreation, aesthetics and wildlife management could not be included and should be most important considerations where clearcutting is proposed. Experience with large clearcuts in Alberta is limited, therefore our conclusions and recommendations are based almost entirely on an interpretation of the literature and our judgment and experience as forest scientists.

315
Johnson, N.K.;
Controls on the number of bird species on montane islands in the Great Basin.
Evolution 29:545-567 1975

KEYWORDS: bird-habitat relationships;avian diversity;migratory status;habitat diversity;forest area;boreal forest;USA

ABSTRACT: *Stepwise multiple regression and path coefficients are used to clarify patterns of inter-correlation and causality in an analysis of controls of boreal bird species numbers on 20 mountaintop islands and 11 sample areas within adjacent "continents" of the Sierra Nevada-Cascade Mountains and Rocky Mountains in the western United States. Total area and area of forest-woodland, variables of significance in other, similar studies, here predict only from 28 to 45% of the variation in total species numbers. In contrast, an index of habitat diversity explains 91% of the variation in total bird species.

316
Johnson, P.C.; Denton, R.E.
Outbreaks of the western spruce budworm in the American northern Rocky Mountain area from 1922 through 1971.
USDA For. Serv. Intermt. For. and Range Exp. Stn., Ogden, Utah, Gen. Tech. Rept. INT-20. 144 p. 1975

KEYWORDS: spruce budworm;outbreaks;host tree species;host tree impacts;biological control;chemical control;USA

ABSTRACT: The western spruce budworm has severely damaged more than 15 million acres of publicly and privately owned coniferous forests chiefly in the American northern Rocky Mountain area. Abundant information about behavior of the budworm, characteristics of outbreaks of its populations, and kinds and severity of damage is available from National Forest ranger district.

317
Johnson, R.R.; Jones, D.A., eds.
Importance, preservation and management of riparian habitat: a symposium.
USDA For. Serv., Gen. Tech. Rep. RM-43. 217 p. 1977

KEYWORDS: riparian habitat;preservation;management

ABSTRACT: **A symposium dealing with various aspects of riparian habitats and their management.

318
Johnson, R.R.; McCormick, J.F., tech. coord.
Strategies for protection and management of floodplain wetlands and other riparian ecosystems.
USDA For. Serv., Gen. Tech. Rep. WO-12. 410 p. 1978

KEYWORDS: riparian habitat;floodplain wetlands;habitat protection;habitat management;bird-habitat relationships

ABSTRACT: *A symposium covering the value of riparian habitats, the effects of forest practices on this habitat, and means of preserving and managing it.

319
Johnston, D.W.;
High density of birds breeding in a modified deciduous forest.
Wilson Bull. 82:79-82 1970

KEYWORDS: avian ecology;avian density;breeding bird populations;modified habitat;edge effect;deciduous forest;Virginia USA

ABSTRACT: The high density of breeding birds at the study site appears to be attributable to two principle factors. First, as compared with vegetational aspects found in neighboring forests, artificial plantings of rhododendron and hemlock increased the shrub layer, thus increasing an edge-effect and more nesting sites for certain species. Second, and probably or greater significance than nesting site alone, is the fact that a partial clearing of the forest increased the distance between trees and introduced open spaces both horizontally and vertically, thereby effectively increasing feeding areas for many species.

320

Johnston, D.W.;
Decline of DDT residues in migratory songbirds.
Science 186: 841-842. 1974

KEYWORDS: pesticides: effects of;migratory birds;passerines;Florida USA

ABSTRACT: Analyses of ten species of migratory songbirds killed when the birds flew into television towers in Florida showed a progressive decline in the concentration of DDT and its metabolites (DDD and DDE) in their fat depots for the periods 1964 to 1973. This decline is apparently correlated with the decreased usage of DDT in the U.S. during the same time.

321

Johnston, D.W.;
Organochlorine pesticide residues in small migratory birds, 1964-1973
Pesticide Monit. J. 9:79-88 1975

KEYWORDS: pesticides;organochlorine residues;migratory birds;foraging behaviour;DDT residues;tissue samples

ABSTRACT: Chlorinated hydrocarbon pesticide burdens, especially those of DDT and its metabolites, have been determined for 19 species of small terrestrial migratory birds killed chiefly at Florida television towers from 1964 to 1973. All 128 samples were sorted into pools by species. All pooled samples except one contained DDE and after DDT and DDD; dieldrin was present in 60 of the samples; but no PCB's were detected. In small subsamples, DDT residues sometimes differed between males and females, adults and immatures, and northbound and southbound migrants but results of these comparisons were inconclusive. DDT burdens were highest in adipose tissue and much lower in liver and brain samples. Especially among birds taken since 1970 have the pesticide levels in adipose tissue been at low levels, generally less than 3 ppm DDT. These low quantities are comparable to those quoted in other reports on birds of similar trophic levels. The insectivorous and/or partly granivorous birds feeding on or near the ground tended to have higher DDT levels than did the one arboreal species.

322

Johnston, D.W.; Odum, E.P.
Breeding bird populations in relation to plant succession on the Piedmont of Georgia.
Ecology 37:50-62 1956

KEYWORDS: avian ecology;avian density;breeding bird populations;bird-habitat relationships;vegetation succession;avian succession;Georgia USA

ABSTRACT: Ten 20-acre areas representing successive stages in the secondary upland sere of the Piedmont region of Georgia, and three areas of cultivated grassland were censused for breeding birds using the territory-mapping method. Essentially, the series of seral stages involved four broad plant life forms which succeed one another as follows: grassland, shrubland, pine forest, and hardwood forest. Breeding bird densities of 15 to 40 pairs per 100 acres in recently abandoned fields increased to 136 in 20-year-old shrublands, decreased to 87-93 in young pine forests, and increased as the hardwood understory developed in older pine forests to 239 pairs in a 100-year-old pine stand and 228 in a young oak-hickory stand. Thus, a trend toward increased density and number of species with succession from bare ground to the late sub-climax or young climax was interrupted by low densities encountered in young pine forests. Birds appear to exert their greatest effect on succession during the intermediate stages, especially during the shrub stages and during the invasion of hardwoods.

323

Jones, P.H.;
Succession in breeding bird populations of sample Welsh oakwoods.
British Birds 65:291-299 1972

KEYWORDS: avian ecology;avian diversity;avian density;breeding bird populations;forest succession;avian succession;land use impacts;management implications;oak woods;Wales

ABSTRACT: Census plots were set out in woods comprising development stages of sessile oak in western Wales. Bird population density was measured by the mapping method; from 12 pairs/sq km in open ground, the population density rose, though checked at the high scrub stage, to 908 pairs/sq km in mature oak with gaps and scrub. The number of breeding species was closely related to the population density, and might be used in future to give an indication of the density and also of the standing biomass in other Welsh oakwoods.

324

Karr, J.R.;
Habitat and avian diversity on strip-mined land in east-central Illinois.
Condor 70:348-357 1968

KEYWORDS: avian ecology;avian diversity;avian density;avian biomass/energy;vegetation succession;avian succession;strip-mined site;land use impacts

ABSTRACT: Bird populations were studied on four successional stages following strip-mining from bare-ground to bottomland forest. Quantitative data are presented to show the present development of vegetation on each study area. The rate of revegetation was affected by the manner in which the area was mined and the amount of reclamation work done after mining, in addition to time since mining. Bird species diversity increased throughout the strip-mined sere and was linearly correlated with foliage-height diversity and the logarithm of per cent vegetation cover. Analysis of relationships between energy requirements expressed as consuming biomass or as existence energy requirements indicated a linear relationship between these factors and habitat structure as measured by either foliage-height diversity or the logarithm of per cent vegetation cover. These data indicate that avian-species diversity and energy requirements of the avian population are related to habitat structure.

325

Karr, J.R.;
On the relative abundance of migrants from the North temperate zone in tropical habitats.
Wilson Bull. 88:433-458 1976

KEYWORDS: avian ecology;migratory birds;bird-habitat relationships;relative abundance;tropical wintering habitat;Indomalaysian;Africa;Panama

ABSTRACT: Variation in the intensity and objectives of studies on species which winter in tropical regions makes the derivation of a comparative synthesis difficult. An examination of my own data combined with review of published literature shows that the abundance of migrants from the temperate zones varies with: (1) vegetation type; (2) elevation; (3) food type; (4) season within each of the 3 major geographical areas considered in this paper. In addition, there is variation (5) between continents and adjacent islands and (6) among the continents. In general, it appears that the evolutionary strategies of migrant birds are keyed to the exploitation of superabundant and/or sporadically available resources in their tropical wintering areas. These resources are often most easily exploited in disturbed, transitory, or isolated patches of habitat.

326

Karr, J.R.; Roth, R.R.
Vegetation structure and avian diversity in several New World areas.
American Naturalist. 105:423-435 1971

KEYWORDS: avian ecology;avian diversity;avian-habitat relationships;vegetation structure;habitat heterogeneity;Panama;Bahamas;Texas

ABSTRACT: Data on avian community structure and vegetation structure for Illinois, Panama, Texas, and Bahama study areas are discussed. Bird species diversity is linearly related to foliage height diversity and sigmoidally related to the percent vegetation cover. Under some circumstances, the volume of vegetation in addition to the layering and distribution among the layers is important as a predictor of bird species diversity. Historical factors seem to be of importance in some phases of the evolution of avian diversity. Horn's Rh, an inverse measure of overlap, applied to tropical and temperate bird and vegetation data, and other considerations indicate that horizontal habitat selection is more precise in mature tropical habitats than in temperate or less mature tropical habitats. These differences are attributed to restriction of species to narrower adaptive peaks in diverse faunas than in less diverse ones. Data indicating more precise vertical habitat selection in tropical habitats are more equivocal. Earlier suggestions of increased microspatial heterogeneity in homogeneous tropical habitats as compared with similar temperate areas, and distinctions between standing crop diversity and existence energy diversity regressed on foliage height diversity are not substantiated.

327

Kayll, A.J.;
The role of fire in the boreal forest of Canada.
Can. Forestry Serv., Petawawa Forest Exp. Stn., Chalk River, Ontario. Info. Rep. PS-X-7. 15 p. 1968

KEYWORDS: boreal forest;fire;regulatory agent;succession: plant/soils/animals

ABSTRACT: Through a review of literature, the essential role of fire in the boreal forest as a natural regulatory agent of composition and succession is discussed in terms of plants, soils, and animals. In natural, long-term cycles, the incidence of lightning-started fires on a particular area may have been only once in one to three centuries, but fire nevertheless has always been an agent for destruction and renewal of boreal forest stands. It is suggested that fire's beneficial effects, e.g. nutrient cycling, removal of excessive mor humus, warming of soil surface, depression of permafrost, provision of browse, etc. should be utilized in managing the forest's renewable resources. Research on physical, physiological, and ecological effects of fire well supplement the meagre experience available for effective management of the boreal forest.

328

Keast, A.; Morton, E.S.
Migrant birds in the Neotropics: ecology, behavior, distribution and conservation.
Washington, Smithsonian Inst. Press. 1980

KEYWORDS:

ABSTRACT: not reviewed

329

Keisker, D.G.;
Nest tree selection by primary cavity-nesting birds in south-central British Columbia.
B.C. Min. Env. and Parks, Victoria, B.C. Wildl. Report R-13. 1987

KEYWORDS:

ABSTRACT: not reviewed

330

Keith, J.O.; Hunt, E.
The relation of pesticides to wildlife in forest management.
Pp. 26-29. In: H.C. Black, ed. Wildlife and forest management in the Pacific Northwest. Oregon State Univ., Sch. For., For. Res. Lab., Corvallis. 1969

KEYWORDS: pesticides: effect of;insecticides;herbicides: effects on habitat;forest management;avian fauna;post-spraying responses;management implications

ABSTRACT: The interactions of pesticides in the environment are reviewed. Pesticides are widely dispersed throughout the environment and residues are prevalent in wildlife. Degradation in environmental quality may result from the activities of a single individual, and the effects of individual programs for pest control should be considered in relation to the total environment. The system concept in ecology is advocated in regulating application of pesticides because "We can never do just one thing." Examples of indirect effects of pesticides on mammals, birds, and fish are cited. Application of compound 1080 and endrin in reforestation are criticized. The fate of compound 1080 in the environment is mostly unknown. The authors warn that a re-evaluation is needed of practices for controlling forest rodents. Endrin is being discontinued in California, and a prediction is made that additional restrictions will be placed on use of persistent insecticides in forests and other areas. The conclusion is drawn that current attitudes of "doers" in society must change if we are to preserve the aesthetic and economic values of our environment.

331

Kelsall, J.P.; Telfer, E.S.;Wright, T.D.
The effects of fire in the ecology of the boreal locust with particular reference to the Canadian north: a review and selected bibliography.
Can. Wildl. Serv. Occas. Pap. 32, 58 pp. 1977

KEYWORDS: fire;boreal forest;forest succession;mosaic effects;avian populations

ABSTRACT: *Wildfire partially or fully destroys forest communities and extensively changes the vegetative structure and occasionally the plant-species composition of such communities. Pioneer species of plants that regenerate in or invade burned areas are frequently short-lived in comparison with the long-lived climax species (white and black spruce in the north), and pioneer species tend to produce light, easily disseminated seeds in numbers that favour colonization of burned tracts. Whether such changes are positive or negative depends on man's view of the primary values of forest areas. Where forestry practices prevail, fires are generally viewed as bad; where hunting and trapping is of greatest importance, fires are viewed as beneficial when replacement species are of greater value than those that were present before the fire. Several examples of the effect of fire on boreal forest birds are given.

332

Kendeigh, S.C.;
Breeding birds of the beech-maple-hemlock community.
Ecology 27:226-245 1946

KEYWORDS: avian diversity;avian distribution;bird-habitat relationships;forest structure;forest succession;beech-maple-hemlock forest;New York USA

ABSTRACT: *(1) Five major biotic communities (ponds and marshes, grassy fields, mixed shrubs and small trees, hemlock-beech forest, and beech-maple-hemlock forest) are of importance in the analysis of avian distribution. (2) At progressively higher elevations, the mixed beech-maple-hemlock forest is replaced by a nearly pure deciduous forest of beech and sugar maple with yellow birch coming in at higher elevations, and then by spruce-fir. At lower elevations in the Hudson River Valley, oaks, hickories, maples, and formerly, chestnut predominate, with a sprinkling of hemlock and white pine. Differences in species composition and size of the bird population are noted in each type of forest. The present restriction of several species to higher elevations is probably due to the prevalence there of natural conditions from which they have not been extirpated as they have in the greatly disturbed forests at lower elevations. (3) There is evidence that the premeval forest contained several species of birds not now found in the area. With the maturing of the present secondary forest there will likely be a reinvasion of birds belonging to the evergreen forest. A further penetration by species of the deciduous forest and its seral stages is also probable. (4) A comparison of the avifauna of the mixedwood forest studied with the deciduous forest biome to the south and the evergreen forest biome to the north indicates that it derives practically all its members from these biomes.

333

Kendeigh, S.C.;
Bird population studies in the coniferous forest biome during a spruce budworm outbreak.
Dep. Lands and For., Ont., Can., Biol. Bull. 1:31-34 1947

KEYWORDS:

ABSTRACT: not reviewed

334

Kendeigh, S.C.;
Bird populations and biotic communities in northern lower Michigan.
Ecol. 29:101-114 1948

KEYWORDS: avian ecology;avian communities;avian diversity;forest structure;forest succession;bird-forest relationships;avian succession;Michigan USA

ABSTRACT: *Biotic communities are best delimited by the life-form or structure of the dominant vegetation correlated with the occurrence of distinct groupings of animal species. Biotic communities are named after two characteristic, predominant, and conspicuous animals and the type of vegetation or habitat. The climax biotic community is called a biociation. Seral biotic communities are designated biocies. The biociation may include several "associations" and late seral "associes". The biocies may likewise include several early seral associes. All seral and climax communities in a unit area may be collectively known as a "biome". The composition and density fro the bird population were determined for the following communities in northern Lower Michigan: Poa consocies of the Sturnella-Ammodramus grassland biocies. Populus-Acer (rubrum) associes of the Vireo-Seiurus broad-leaved forest biociation. Fagus-Acer-Pinus association of the Vireo-Seiurus broad-leaved forest biociation. Pinus-Populus associes of the broad-leaved forest-needle-leaved forest ecotone. Thuja-Populus associes of the Zonotrichia-Oporornis forest-edge biocies. Thuja-Abies associes of the Dendroica-Regulus needle-leaved forest biociation.

335

Kerlinger, P.; Doremus, C.
Habitat disturbance and the decline of dominant avian species in pine barrens of the northeastern United States.
Am. Birds. 35:16-20 1981

KEYWORDS: habitat disturbance;forest fragmentation;avian ecology;fire suppression;avian diversity;nest predation;pine barrens;New York USA;New Jersey USA

ABSTRACT: Habitat alterations such as size reduction, dissection and fire suppression have resulted in large scale changes in the structure of pine barren avian communities. Disturbances have left small tracts of barrens bounded by habitats unsuitable or less suitable as breeding areas of characteristic pine barren birds. Reduced abundance and absolute densities of Prairie Warbler, Brown Thrasher, Ovenbird and Pine Warbler have occurred in some habitats at Albany and Long Island. The Pine Warbler and Eastern Bluebird no longer breed at Albany. Gray Catbird, American Robin, Northern Oriole, Brown-headed Cowbird, Indigo Bunting and Field Sparrow have become more numerous in these ecotone or edge habitats. Nest parasitism by the Brown-headed Cowbird and predation by other animals may be high on these disturbed sites. Further disturbances at Albany and Long Island may cause less desirable species to become even more abundant, while characteristic pine barren species may further decline or disappear.

336

Kessler, W.B.;
Bird population responses to clearcutting in the Tongass National Forest, Southeast Alaska.
Unpub. report. prepared by Univ. of Idaho, College of For. Moscow, Idaho, for U.S. For. Serv, Tongass National Forest, Ketchikan, Alaska. 63 pp. 1979

KEYWORDS: clearcutting;site preparation;planting;forest succession;post-logging responses;avian diversity;avian density;bird-habitat relationships;management implications;coniferous forest;Alaska USA

ABSTRACT: **In 1978 a study was undertaken to evaluate clearcutting effects on habitat structure and forest bird species of the Tongass National Forest. Relative bird densities were estimated for six seral stages of western hemlock-sitka spruce stands: 1) recent clearcut, less than 5 yr; 2) shrub/sapling, 11 yr; 3)sapling/shrub, 17 yr; 4)pole, 30 yr; 5) young sawtimber, 80 yr; and 6) old growth, 150+ yr. Avian diversity was lower in recent clearcuts. Avian diversity increased during the mid-successional phases, though five mid-successional species were absent in the 80 yr stands. Four species absent from early successional stages reached highest population index values in forested stands. Overall, 10 species increased as a result of clearcutting, 7 species decreased in abundance, and for 4 species the data was inconclusive.

337

Kessler, W.B.;
Bird populations of riparian habitats in the Tongass National Forest of Southeast Alaska.
US For. Serv., Ketchikan, Alaska. Unpubl. paper. 57 p. 1980

KEYWORDS: riparian habitat;clearcutting;avian density;post-logging responses;bird-habitat relationships;indicator species;Alaska USA

ABSTRACT: **Bird populations and habitat characteristics in six types of riparian habitat were studied as part of a data collection process to inventory the nongame birds of the Tongass National Forest and to relate population levels to existing forest management practices (clearcutting). Relative bird densities in all riparian types were estimated by a modified line transect method, and reported as Population Index values. Species orientations were classified along successional gradient, and species-habitat matrices were provided for logged and unlogged riparian habitats. Indicator species were chosen to represent mature and old growth, and mid-successional stages.

338

Kessler, W.B.; Kogut, T.E.
Habitat orientations of forest birds in southeastern Alaska.
Northwest Science 59:58-65 1985

KEYWORDS: forest birds;habitat orientation;riparian habitat;silviculture;thinning;clearcuts;post-logging response;old-growth forest;forest succession;management implications;Alaska USA

ABSTRACT: Spring/summer bird surveys were conducted in coastal forest stands in southeast Alaska in 1978 and 1979. The 10 habitat categories surveyed included riparian and nonriparian situations and a successional sequence from new clearcuts to old growth. For 35 species recorded, over half of total observations were contributed by the Winter Wren, Dark-eyed Junco, Golden-crowned Kinglet, Chestnut-backed Chickadee, and Orange-crowned Warbler. Lowest species richness occurred in new clearcuts and in young second-growth sawtimber. Riparian situations supported greater avian abundance and species richness than did riparian stands of the same successional stage. Trends in avian occurrence are related to stand structural changes that occur through the successional sequence. Silvicultural practices such as thinning may have potential to enhance habitat structure and avian diversity in managed second-growth stands.

339

Kilgore, B.M.;
Breeding bird populations in managed and unmanaged stands of Sequoia gigantea.
Ph.D. Thesis. Univ. Berkley, Calif. 196. 1968

KEYWORDS:

ABSTRACT: not reviewed

340

Kilgore, B.M.;
Response of breeding bird populations to habitat changes in a giant sequoia forest.
American Midland Naturalist. 85:135-152 1971

KEYWORDS: habitat disturbance;timber management;prescribed burns;understory removal;breeding bird populations;avian diversity/biomass;avian-habitat relationship;sequoia forest;Sierra Nevada;California USA

ABSTRACT: Thirty species from the montane forest formation comprised most of the breeding bird population of a giant sequoia forest, with a density ranging from 188 to 311 pairs per 100 acres (40 ha). When some 22 tons of living and dead trees per acre in the brush or sapling layer of this forest were eliminated by cutting, piling and prescribed burning, the change in character of vegetation and the openness of the low vegetation zone led to changes in species composition but not in total biomass of the avifauna. This was true because thickets of small trees were the least important vegetation for bird feeding or nesting; the upper canopy and understory were most important, followed by the ground and trunk categories. Two species of ground-nesting species disappeared after treatment. Nesting flycatchers and robins increased in numbers. Compared with results from areas where wildfires or logging operations have made substantial changes in cover type and set succession back severely, this degree of habitat modification resulted in relatively small avifaunal changes.

341

Kimball, A.J.;
Effects of silviculture and ownership on forest diversity.
Pp. 57-68 in: J.A. Bissonette, ed. Is good forestry good wildlife management? Proc. of a Joint Conference, March 6-8, 1985, Portland, Maine. 1986

KEYWORDS: forest diversity;silviculture;forest fragmentation;intermediate-treatments;herbicides;thinning;clear cutting;selection cutting;biomass harvesting;management implications

ABSTRACT: Increasing wildlife productivity by enhancing habitat diversity has long been a goal of wildlife managers. This paper defines the components of forest diversity and explores ways that silvicultural techniques can be used to foster or discourage those components. Because silvicultural practice is designed to meet the objectives of the landowner, the paper also considers some of the implications of current trends in land use patterns in the northeast.

342

Kitts, J.R.;
Snags for wildlife.
University of Minnesota Agric. Ext. Serv., Exten. Folder. 581. 1981

KEYWORDS:

ABSTRACT: not reviewed

343

Knight, F.R.;
The effects of woodpeckers on populations of the Engelmann spruce beetle.
J. Econ. Entomol. 51:603-607 1958

KEYWORDS: spruce beetle;bird-insect relationships;woodpeckers;spruce: Engelmann

ABSTRACT: Woodpeckers have been recognized for many years as a major factor in the natural reduction of Engelmann spruce beetle populations. A means of assessing their value has been developed. Five classifications of woodpecker feeding based on woodpecker work on 225 trees were studied. An analysis of population measurements showed a correlation between beetle survival and the woodpecker classification and the intensity of infestation in each tree. A heavy woodpecker classification resulted in very little survival at all intensities of infestation. Survival increased both with an increase in intensity of infestation and a lower woodpecker classification. The average reduction in populations increased progressively from 45 to 98 per cent as the woodpecker classification, which was highly correlated with caged survival, progressed from light to heavy. After woodpecker feeding, numerical survival of beetles was greatest in the moderate classification. The effects of woodpeckers on populations of the Engelmann spruce beetle can be evaluated by classifying woodpecker work and measuring the intensity of beetle infestation in the tree.

344

Komarek, E.V. Jr.;
Fire and animal behaviour.
Proc. Tall Timber Fire Ecol. Conf. 9:161-207 1969

KEYWORDS: fire;bird behaviour;foraging behaviour

ABSTRACT: **The responses of several types of animals to fire are described in this paper. Several examples are given of bird species which are attracted to burning areas in response to prey availability.

345

Komarek, R.;
Fire and the changing wildlife habitat.
Proc. Tall Timber Fire Ecol. Conf. 2:35-43 1963

KEYWORDS: fire;vegetation succession;wildlife habitat;forestry management

ABSTRACT: *Land management where wildlife is concerned, if it is to be successful, must recognize the instability of the habitat and provide measures to maintain and control vegetative patterns once they have been established. Considering the wide range of native vegetation types which supported an abundant and varied wildlife and timber growth in the past, a pretty fair job of "management by uncontrolled fire" had taken place before the white man reached this continent. It is generally accepted that fire was at least one of the prime ecological factors responsible for this varied mantle of vegetation. It would not be surprising if a good, basic management program could be written for a large number of wildlife species simply by the judicious use of controlled burning coupled with the exclusion of fire where necessary to maintain a diversified pattern of vegetation.

346

Koonz, W.H.;
The bald eagle in Manitoba.
Department on Natural Resources, Wildlife Branch-Biological Services. Tech. Rep. No 88-1. 12 pp. 1988

KEYWORDS: bald eagles;range;nest sites;productivity;food habits;migration;human disturbance;mitigation;management implications;Manitoba

ABSTRACT: Bald Eagles breed throughout Manitoba except in the Hudson Bay Lowlands and in southern agricultural areas. Nests are 3-20 meters off the ground in deciduous and coniferous trees. Nests are usually on islands, with active nests seldom less than a kilometer apart. Most are in sight of water, particularly fast water in the north. Nests may be used for 20 or more successive years. Breeding densities vary according to human disturbance, water turbidity and availability of food and nest sites. Eagles arrive at nest sites by early April and are incubating by month's end. Young fledge at 10-12 weeks of age, from the middle of July to mid-August. Fall migration begins when major lakes begin to freeze over in October; however, individuals may attempt to overwinter in the province near food sources such as piles of discarded fish or where animal carcasses have been left by a trapper. Manitoba eagles are opportunistic but feed primarily on fish during the breeding season. They may rely on other food sources in migration or in special circumstances. Both sexes attain adult plumage and sexual maturity at 4-5 years of age. Forested and semi-agricultural areas of Manitoba were systematically surveyed for nesting eagles each summer from 1982 to 1987. It is estimated that over 1300 pairs of Bald Eagles nest in Manitoba annually. A fall estimate of 8000 individuals for the province is considered conservative.

347

Koplin, J.R.;
Predatory and energetic relations of woodpeckers to the Englemann spruce beetle.
Ph.D. Diss. Colo. State Univ., Fort Collis. 187 p. 1967

KEYWORDS:

ABSTRACT: not reviewed

348

Koplin, J.R.;
The numerical response of woodpeckers to insect prey in a subalpine forest in Colorado.
Condor 71:436-438 1969

KEYWORDS: woodpeckers;spruce beetles;bird-insect relationships;predator impact;management implications;Colorado USA

ABSTRACT: A deterministic model incorporating food requirements of free-living woodpeckers, average number of prey per woodpecker stomach, population density of woodpeckers, and air temperature as inputs, and yielding number of prey consumed as output, was formulated to predict predatory impact of three individual species of woodpeckers on endemic, epidemic and pan-epidemic populations of larval spruce beetles. Resultant predictions compared favorably with estimates made by measuring relative survival of larvae inside and outside of woodpecker exclosures. The model predicted that northern three-toed woodpeckers were the most effective and downy woodpeckers the least effective picid predators of larval spruce beetles. It is speculated that the graded predatory effectiveness- the result of differential functional and numerical responses of woodpeckers to density of spruce beetles- was related to foraging adaptations characteristic of each species. The combined predatory impact of the woodpeckers was least effective on epidemic populations. It is also speculated that decreased predatory effectiveness on endemic populations is related to the availability of alternate prey and to adaptions of woodpeckers for utilizing them, and that decreased predatory effectiveness on pan-epidemic populations is related to the limitations imposed by nesting territoriality on the numerical response of woodpeckers to prey density.

349

Koplin, J.R.;
Measuring predator impact of woodpeckers on spruce beetles.
J. Wildl. Manage. 36:308-320 1972

KEYWORDS: woodpeckers;numerical response;bird-insect relationships;insect predation;Colorado USA

ABSTRACT: During the fall of 1964 resident populations of Northern Three-toed, Hairy, and Downy Woodpeckers concentrated upon bark beetles attracted to 10 acres of northern Colorado subalpine forest killed by a fire in 1962. The numerical response of the woodpeckers was graded; that of the Northern Three-toed Woodpecker was the most pronounced and that of the Downy Woodpecker least pronounced. Evidence is presented suggesting that the graded response was related to the foraging adaptations of each species of woodpecker.

350

Koplin, J.R.; Baldwin, P.H.
Woodpecker predation on an endemic population of Englemann spruce beetles.
Am. Midl. Nat. 83:510-515 1970

KEYWORDS: bird-insect relationships;spruce beetles;woodpecker predation

ABSTRACT: Northern three-toed and hairy woodpeckers consumed 2 to 26% of the brood of an endemic population of the Engelmann spruce beetle. Predation was restricted to the second-year brood and decreased the survival of this age-class by 13 to 25%. Factors to account for the disproportionate losses of first- and second-year brood in the endemic population and for differential losses of brood from the endemic and epidemic populations to woodpecker predation are suggested and discussed.

351

Kricher, J.C.; William, E.D., Jr.
Returns and winter-site fidelity of North American migrants banded in Belize, Central America.
J. Field Ornithol. 57:48-52 1986

KEYWORDS: migratory birds;winter-site fidelity;deforestation: Central/South America

ABSTRACT: North American migrant birds were netted and banded in January of 1982,1983, and 1984 in mature rain forest and 2 recently disturbed areas in Blue Creek, Belize, Central America. Of 19 species banded in 1982 and 1982, 9 had sample sizes of 6 or more individuals and were studied for site fidelity. Previously banded individuals from 6 of the 9 species were recovered in 1983 or 1984. All 16 individuals were recovered in the same study sites in which they were originally banded, in no case at a greater distance than 100 m from their original capture site. Our results indicate high winter site fidelity for these species.

352

Kroodsma, R.L.;
Edge effect on a breeding forest birds along a power line corridor.
J. Appl. Ecol. 19: 361-370. 1982

KEYWORDS: habitat alteration;power-line corridor;edge-effect;avian diversity;avian density;Tennessee USA

ABSTRACT: Territories of breeding birds in a rectangular, 21.4 ha forest plot adjacent to 800 m of a power-line corridor in East Tennessee were mapped in 1975, 1977, and 1979. Trends in density from the corridor edge to 268 m into the forest were examined for the bird community as a whole and for edge, deep forest, and unaffected species. Analysis of computer-generated, randomly distributed 'species' indicated that most trends observed in individual bird species were real. Apparently due to a tendency for some birds to establish territories in a row along the straight corridor edge, peaks in total density occurred at the edge and again in deeper forest. In each year, total density was higher at some distance into the forest than at or near the edge. The contribution of 5 edge species to bird density on the plot as a whole was negated by lower densities of 9 deep forest species in areas near the edge. Considered as a group, 13 forest species that individually appeared unaffected by the corridor showed a significant decrease in density with increasing distance from the corridor edge; this may have been caused by the higher bird density in a small amount of mixed forest habitat near the corridor.

353

Lack, D.;
Habitat selection in birds with special references to the effects of reforestation on the Breckland avifauna.
J. An. Ecol. 2:239-262 1933

KEYWORDS: reforestation;avifauna;bird-habitat relationships;habitat selection;avian succession;England

ABSTRACT: **The succession of avifauna on reforested land (ranging from 0-11 year-old plantations) is described in this paper. Avifauna composition changed from only birds found in open heath to species found only in afforested areas at the later stages of forest succession observed.

354

Lack, D.;
Further changes in the Breckland avifauna caused by afforestation.
J. Anim. Ecol. 8:277-285 1939

KEYWORDS: afforestation;pine plantations;avifauna;forest succession;avian succession;England

ABSTRACT: Detailed figures from walking counts are given, comparing the successive breeding and mid-winter bird populations of Beckland heaths and pine plantations from 4 to 15 years old. (1) Both in summer and winter, the changes in the population resulting from the increasing height of the trees are extremely striking. (2) Comparison with Schiermann's data for North German pine plantations reveals many similarities in distribution, but chaffinch and coat tit colonize the British plantations much earlier than they do the German ones. (3) The factors limiting distribution are discussed. For colonizing species, song posts and to a less extent nest sites are the most important factors.

355

Lack, D.; Lack, E.
Further changes in bird life caused by afforestation.
Jour. Animal Ecology. 20:173-179 1951

KEYWORDS: afforestation;plantations;forest succession;avian ecology;avian diversity;avian succession;breeding birds;England

ABSTRACT: Further changes in the bird-life of the Breckland consequent on the growth of pine plantations are described in both summer and winter, and summarized. Various differences were found in the bird-life of Scots and Corsican Pine. The titmice population of the Breckland differed markedly in two winters. The winter populations of conifer plantations in other parts of Britain are summarized.

356

Lancia, R.A.; Adams, D.A.
A test of habitat suitability index models for five bird species.
Proc. Annu. Conf. Southeast. Assoc. Fish and Wildlife Agencies. 39:412-419 1985

KEYWORDS: models: species-habitat;habitat suitability indices;bird species;model validation

ABSTRACT: Habitat Suitability Index (HSI) models for 5 bird species were tested with spatially-referenced habitat and frequency of use data using a computerized grid-cell mapping system (SYMAP) and the Statistical Analysis System (SAS). According to our spatial approach for testing, pine and prairie warbler models performed well-better than those for eastern bluebirds or red-cockaded and pileated woodpeckers; however, the poor performance of the latter models was probably due more to the testing paradigm and/or to a low number of observed birds than to the models themselves. Models should be tested at scales commensurate with home ranges over an appropriate range of habitat suitability.

357

Landers, P.B.; MacMahon, J.A.
Guilds and community organization: analysis of an oak woodland avifauna in Sonora Mexico.
Auk 97:351-365 1980

KEYWORDS: avian ecology;avian community organization;foraging guilds;spatial distribution;oak woodland;Mexico

ABSTRACT: Community organization of an oak woodland breeding avifauna was studied in Sonora Mexico. Species were classified into guilds by quantifying foraging behavior, based on investigator-defined resource classes, and subjecting these data to cluster analysis. From this analysis five guilds were recognized: Foliage gleaning, wood gleaning, wood probing, air sallying, and ground sallying. Within each resource class all guilds foraged in a significantly different manner, except for air and ground salliers. Species within guilds were most often separated by food site and perch height. Use of height classes by the avian community was significantly different from the quantity of tree vegetation per height class. Differential height utilization generally resulted from gleaning and probing guilds foraging at upper heights and sallying guilds foraging at lower heights. Ecological separation within and among guilds is discussed and related to community organization in this oak woodland avifauna. When the guild structure of this community is compared to other oak woodland avifaunas, a decrease in foliage gleaners of nearly 2.5 fold and a 6.4 fold increase in salliers occur from Oregon to Sonora, Mexico. Utility of the guild approach is discussed in relation to some prominent questions raised by results of the above comparison concerning 1)foraging plasticity in species coexistence and 2) change in community structure over time and between geographic locations.

358

Lanier, J.W.;
Integrated forest-wildlife management on the White Mountain National Forest.
Pp. 325-332 in: J.A. Bissonette, ed. Is good forestry good wildlife management? Proc. of a Joint Conference, March 6-8, 1985, Portland, Maine. 1986

KEYWORDS: Integrated forest-wildlife management;indicator species;bird-habitat relationships;habitat management;management implications

ABSTRACT: The wildlife habitat management strategy of the White Mountain National Forest (WMNF) is directed at the entire forest. For the purposes of this paper, the portion of the Forest that is managed for timber production is discussed. In this portion, habitat management units of approximately 4000 acres each were established, based upon moose home range size. Each habitat management unit is assigned an ideal set of composition objectives (a distribution of community types). Management indicator species were selected for each community type that was determined to be important. Indicator species populations will be monitored and composition objectives of habitat management units adjusted over time to maintain viable populations of all indicator species on the Forest.

359

Larsen, J.A.;
The Boreal Ecosystem.
Academic Press, New York. 1980

KEYWORDS: boreal ecosystem;avian diversity;avian biomass;breeding populations;review

ABSTRACT: **In this book small, forest-inhabiting birds are viewed as integral components of the boreal forest ecosystem. Information on avifaunal biomass, species diversity, and breeding populations is reviewed.

360

Larson, F.R.; Ffolliott, P.F.;Rasmussen, W.O.;Carder, D.R.
Estimating impacts of silvicultural management practices in forest ecosystems.
Pp. 281-294 in: Loehr, R.C., D.A. Haith, M.E. Walter. and C.S. Martin, eds., Proc. 1978 Cornell Waste Manage. Conf., Ithaca, NY. 1979

KEYWORDS:

ABSTRACT: not reviewed

361

Lautenschlager, R.A.;
Forestry, herbicides, and wildlife.
Pp. 299-307 in: J.A. Bissonette, ed. Is good forestry good wildlife management? Proc. of a Joint Conference, March 6-8, 1985, Portland, Maine. 1986

KEYWORDS: forestry management;herbicides;songbirds: effects of herbicide;bird-habitat relationships;management implications

ABSTRACT: At present application rates, herbicide conifer release in the northeast probably affects wildlife populations little. However, if herbicide conifer release increases greatly, it will: reduce the ability of treated areas to support moose and small mammal populations for a short period following treatment; at most cause a short term reduction of deer and hare populations, which are more likely to benefit within a few years after application; and benefit warblers and associated bird species normally found in the spruce/fir forest. Although herbicide conifer release could benefit a variety of forest wildlife, forestry herbicides have developed an unjustified negative reputation. That reputation is based on: environmental fears and generalizations developed in the 1960's; herbicides' incorrect association with other, more toxic, chemicals (e.g., insecticides); and the inability of some resource workers and the media (and therefore the public) to distinguish among the variety of pesticides. To help eliminate this confusion it is imperative that resource professionals use "pesticide" only when a more specific term (insecticide, herbicide, fungicide etc.) is inappropriate.

362

Lawrence, G.E.;
Ecology of vertebrate animals in relation to chaparral fire in the Sierra Nevada foothills.
Ecology 47:287-291 1966

KEYWORDS: fire;chaparral;vertebrate animals;avian ecology;post-fire responses;predation;California USA

ABSTRACT: Chaparral fire brings decided changes in the species composition and density of both plant and animal populations in the Sierra Nevada foothills. Some species decrease whereas others increase following a burn, but no species is totally eliminated, nor is there any apparent diminution of total life on a burn after plant growth resumes. However, in the bare ash after the fire many species were severely exposed to predation, and populations of most small mammals and some brush-dwelling birds decreased rapidly. Predatory birds and mammals increased, as did some seed-eating birds that found good foraging on the exposed earth. Birds and mammals that normally exhibit a strong preference for chaparral habitat were substantially reduced in numbers in the years following the burn. Conversely, some of the birds that normally prefer grassland or oak woodland increased in number. The fire resulted in an overall increase in densities of nesting birds.

363

Lay, D.W.;
How valuable are woodland clearings to birdlife?
Wilson Bull. 50:254-256 1938

KEYWORDS: clearings: woodland;avian diversity;edge-effect;management implications

ABSTRACT: Thirty-minute time-unit bird counts are useful for expressing the relative abundance of birds in two or more types. An average thirty-minute walk in the margin of a Walker County, Texas, pine woodland clearing may be expected to disclose 16 to 17 birds of 6 or 7 species. A similar walk in the interior of woodland more than 100 yards from the edge of a clearing discloses 8 or 9 birds of 4 or 5 species. The margins of clearings have 95 percent more birds representing 41 percent more species than the interiors of corresponding woodland. In the management of pine woodland the provision of well scattered, small (less-than-thirty-acre) clearings is distinctly favorable to birdlife.

364

Lennartz, M.R.; Bjugstad, A.J.
Information needs to manage forest and range habitats for nongame birds.
Pp. 328-333 in: D.R. Smith, tech. coord. Proc. of the symposium on management of forest and range habitats for nongame birds. USDA For. Serv. Gen. Tech. Rept. WO-1. 1975

KEYWORDS: nongame bird management;information needs;bird-habitat relationships;forest management;status: endangered/threatened;management implications

ABSTRACT: This paper highlights the management information and research needs for nongame birds habitat management as pointed out in previous papers of this Proceedings. It also highlights comments submitted through letters from land managers. A consensus is implied that the management of nongame birds and their habitats is a relatively new resource issue and there is a veritable dirth of information available but badly scattered. Management has had difficulties defining goals and objectives for management.

365

Lennartz, M.R.; Lancia, R.
Old-growth wildlife in second-growth forests: opportunities for creative silviculture.
Pp. 74-103 In: Proceedings of the National Silviculture Workshop: Silviculture for all Resources, Sacramento, California, May 11-14, 1978. USDA For. Serv. Timber Management, Wash, D.C. 1989

KEYWORDS: red-cockaded woodpecker;nesting habitat selection;foraging habitat selection;population status/trends;old-growth forest;second-growth forest;forest management;rotation period;remnant patches/trees;management implications;conservation implications

ABSTRACT: *Our purpose in this paper is to urge both managers and researchers to devote greater energy and imagination to exploring strategies for creating old-growth characteristics and wildlife habitat elements in managed, second-growth forests. Our example is an old-growth wildlife species of the Southeast, the red-cockaded woodpecker. The woodpecker's abundance, distribution, and habitat requirements suggest that at least some "old-growth" species can survive, and perhaps prosper, in properly managed second-growth forests.

366

Levenson, J.B.;
Woodlots as biogeographic islands in southeastern Wisconsin.
Pp. 13-39 in: Burgess, R.L. and D.M. Sharpe eds., Forest island dynamics in man-dominated landscapes. Springer-Verlag, New York, NY. 1981

KEYWORDS:

ABSTRACT: not reviewed

367

Lorenberg, E.I.;
Principal effects of forest clearing on the birds of the European southern Taiga forest
Zool. Zhur. 43:735-743 1964

KEYWORDS: forest clearing;bird populations;post-clearing response;avian succession;geographic distribution;Taiga forest;Europe

ABSTRACT: *In 1960-1963 the absolute population of birds in dark-coniferous southern taiga forests of Kirov region, where the concentrated felling took place, was registered. The population of the most abundant species of birds in forests was found to be relatively stable. The population indices are given which characterize the succession of birds populations on the felling areas of the age from 1 to 11 years. The effect of taiga felling on the population and geographic distribution of great-wood-hazel grouse and certain other species of birds is discussed. The problem is raised on the possibility of the influence of birds on the processes of overgrowing on felling areas by means of transfer of seeds of various plants and, in particular, of raspberry.

368

Lovejoy, T.E.;
Bird species diversity and composition in Amazonian rain forests.
Amer. Zool. 12:711-712 1972

KEYWORDS: avian diversity;bird-habitat relationships;forest structure;rain forests;Amazon

ABSTRACT: Considerable attention had been paid in recent years to relationships between bird species and vegetation structure, in particular, the relationship between the diversity of a vegetation profile as measured by foliage height diversity (FHD) and the diversity of bird species. Large samples of mist-netted birds from a number of rain forest types in the Lower Amazon have very high values of the Shannon-Wiener index of diversity (H' using log base 2). Assuming a reasonable number of horizontal vegetation layers, these values are too high to be predicted by FHD, because FHD cannot measure certain special qualities of rain forests. Somewhat overlooked have been the relationships between bird species and floral species. Using mist-netting data, such a relationship can be sought in Lower Amazonian rain forests with over 200 species of banded birds and over 450 species of trees. In this highly diverse and complex ecosystem tree species composition appears to be a good basis for predicting bird species composition. This does not mean a large number of one-to one relationships exist, but rather that particular bird species are relating to one or more of the following: 1) qualities associated with particular tree species, 2) the vegetation structure which is the consequence of tree species composition, 3) the same environmental gradients (e.g., moisture) to which tree species are interacting.

369

Lovejoy, T.E.;
Tropical deforestation and North American birds.
Bird. Conserv. 1:126-128 1983

KEYWORDS: avian diversity;migratory birds;forest passerines;deforestation: tropical;clearing;conservation mechanisms;America: south/central/ north

ABSTRACT: **The extent of tropical deforestation, the effects of deforestation on wintering North American migratory birds, and conservation mechanisms are briefly discussed in this article.

370

Lovejoy, T.E.; Bierregaard, R.O.;Rankin, J.M.;Schubart, H.O.R.
Ecological dynamics of tropical forest fragments.
Pp. 377-384. In: S.L. Sutton, T.C. Whitmore, and A.C. Chadwick, eds. Tropical rain forest: ecology and management. Blackwell Scientific, Oxford, England. 1983

KEYWORDS: avian ecology;avian diversity;forest fragmentation: tropical forests;management implications;Amazon

ABSTRACT: *The rapid loss of forest in most parts of the tropics lends a particular urgency to conservation. One of the most important aspects of such efforts is to establish a series of protected representative ecosystems of these species-rich biological formations, and this inevitably involves questions of size, shape and the extent of connectability between the reserves and other forest areas. Once what is to be preserved-be it a community or a single species-is determined, information on ecosystem decay will be useful in making management and reserve design decisions. Does ecosystem decay take place in a predictable fashion? Are species lost in a predictable order? Does the decay process behave similarly in different taxonomic groups? Are the resultant assemblages a subset of the original assemblage or something very different?

371

Lovejoy, T.E.; Rankin, J.M.;Bierregaard, R.O.;Brown, K.S.;Emmons, L.H.;Van der Voort, M.E.
Ecosystem decay of Amazon forest remnants.

Pp. 295-325 in: M.H. Nitechi, ed. Extinctions. University of Chicago Press, Chicago. 1984

KEYWORDS: forest fragmentation;forest isolation;avian diversity;avian abundance;Amazon

ABSTRACT: *Subsequent to isolation in October 1980, notable change has occurred in the bird communities of the two isolated reserves. Comparison of birds sampled in the two communities with those sampled from nonisolated reserves indicates that the two isolated communities have become more similar to one another and less similar to nonisolated reserves since isolation. Species encounter functions calculated from post-isolation bird data from the 10 ha reserve climb more slowly the later the initial date of the sample. Thus for an equivalent number of individuals, later samples always consist of fewer species. This indicates that the bird species nets were sampling an increasingly impoverished bird community and confirms that species loss was taking place.

372

Lowe, P.O.;
Potential wildlife benefits on fire in ponderosa pine forests.
M.S. Thesis. Univ. Ariz., Tucson. 131 p 1975

KEYWORDS:

ABSTRACT: not reviewed

373

Lowe, P.O.; Ffolliott, P.F.;Dieterich, J.H.;Patton, D.
Determining potential wildlife benefits from wildfire in Arizona ponderosa pine forests.
USDA For. Serv., Rocky Mount. For. and Range Exp. Stat., Gen. Tech. Rep. RM-52. 12 p 1978

KEYWORDS: fire;forest/avian succession;post-fire responses;avian ecology;foraging guides;avian diversity;management implications;ponderosa pine forest;Arizona USA

ABSTRACT: Large wildfires are frequently destructive to the timber resource, but wildlife may not be so adversely affected. A study of selected species of wildlife (deer, elk, rodents, and birds) that were present on large burned areas, 1,3,7, and 20 years old, indicated population fluctuations and habitat changes that are, for the most part, predictable, and can be expressed in economic terms. An "index to benefits" was developed that converts the flows of benefits or losses after fire to annuities. By assuming values for wildlife use, the manager can interpret these changes in terms of dollars in order to describe the total impact of wildfire on the wildlife resource.

374

Lumen, I.D.; Neitro, W.A.
Preservation of mature forest stages to provide wildlife habitat diversity.
Tran. N. Amer. Wildl. and Natur. Resour. Conf. 45:271-277 1980

KEYWORDS: mature forest seral stages;wildlife habitat diversity;avian habitat;forest management;management proposal

ABSTRACT: *The management of forests for timber production, if done properly, can benefit most wildlife species. The proposal is to structure the timber management program to provide for naturally self-sustaining populations of all native wildlife species. The key to achieve this goal is vegetative diversification. It is proposed, therefore, to manage forest lands so that all vegetative successional stages are adequately represented over time. This proposal would counter the current decline of older seral stands by allotting or planning for a portion of all forest lands to remain in the mid-age and old growth seral stages in perpetuity. A model would be developed for each forest management area to achieve this objective over time. A lesser portion of all forest lands in any one planning area would be maintained in mid-age and old growth seral stages for the benefit of secretive, sensitive and wide-ranging species such as northern spotted owl, pine marten, fisher, and mountain lion. A larger portion of each management area would be in mid-aged and old growth seral stages, averaging 80 acres (32 ha) or more per tract which would be maintained at intervals of approximately one mile if possible.

375

Lynch, J.F.; Whigham, K.F.
Effects of forest fragmentation on breeding bird communities in Maryland, USA
Biol. Conserv. 28:287-324 1984

KEYWORDS: forest fragmentation;forest size;forest structure;avian ecology;breeding bird communities;avian diversity/abundance;forest-interior birds;forest-edge birds;migratory status;Maryland USA

ABSTRACT: Point surveys were used to estimate the abundance and diversity of forest birds in relation to the size, degree of isolation, floristics, physiognomy, and successional maturity of 270 upland forest patches in the coastal plain province of Maryland. Physiognomic and floristic characteristics of the tree, shrub, and herb layers of the forest were measured at each site. The local abundance of almost every bird species breeding in the interior of upland forests was found to be significantly influenced by forest area, isolation, structure, or floristics, or combinations of these factors. Highly migratory species tended to be most abundant in extensive stands of mature, floristically diverse forests that were only slightly isolated from sources of potential colonists. Densities of permanent residents and short-distance migrants tended to be less affected by these site characteristics, or showed responses opposite in sign to those of long-distance migrants. The impacts of forest fragmentation on bird populations are complex and species-specific. Many bird species respond strongly to factors other than, or in addition to, forest patch area and isolation. Dissection of the landscape into small highly isolated patches of forest adversely affects some bird species, but structural and floristic characteristics of the forest are more important than patch size and isolation for many species, given the existing distribution of forest patches in the coastal plain of Maryland.

376

Lynch, J.F.; Whitcomb, R.F.
Effects of the insularization of the eastern deciduous forest on avifaunal diversity and turnover.
Pp. 461-489. in: A. Marmestein, ed. Classification, inventory, and evaluation of fish and wildlife habitat. US Fish and Wildl. Serv. Publ. OBS-78176. 1978

KEYWORDS: forest fragmentation;forest-interior birds;avian diversity;avian abundance;migratory birds;avian turnover;conservation implications;management implications;USA

ABSTRACT: Analysis of breeding bird censuses for isolated tracts of eastern deciduous forest reveals a pattern of general reduction in abundance and diversity of breeding bird species over the past 10 to 20 years. Highly migratory, insectivorous, forest-interior species are most dramatically affected; nearly all species in this group have declined markedly, and many have been extirpated locally. Censuses within larger forested tracts show that such areas are not undergoing the same rapid loss of individuals and species. Species turnover rates are so high in isolated woodlots that important long-term shifts in avifaunal composition and richness tend to be obfuscated by possibly irrelevant short-term colonizations and extinctions by rare or marginal species. Existing urban and suburban parks in the Washington, D.C., area have failed as avifaunal preserves, probably owing to the combined effects of inadequate size, isolation from sources of potential colonists, and increasing levels of disturbance related to human activities. The best hope for preventing regional extinction of numerous forest-interior bird species in the Atlantic coastal plain and piedmont regions is to reverse the current trend toward insularization of remaining forest.

377

Lyon, L.J.; Crawford, J.S.;Czvhai, E.;Fredriksen, R.L.;Harlow, R.F.;Metz, L.J.;Pearson, H.A.
Effects of fire on fauna.
USDA For. Serv. Gen. Tech. Rep. WO-6 Washington DC. 41 p. 1978

KEYWORDS:

ABSTRACT: not reviewed

378

MacArthur, R.H.;
Population ecology of some warblers of northeastern coniferous forests.
Ecology 39:599-619 1958

KEYWORDS: warblers;population ecology;bird-habitat relationships;forest structure;competition;resource partitioning

ABSTRACT: This study was undertaken with the aim of determining the factors controlling the species' abundances and preventing all but one from being exterminated by competition. Five species of warblers (Cape May, myrde, black-throated green, blackburnian, and bay-breasted), which are sometimes found together in the breeding season in relatively homogenous mature boreal forests, were studied. These species are congeneric, have roughly similar sizes and shapes, and all are mainly insectivorous. Of the five species, Cape May warblers and to a lesser degree bay-breasted warblers are dependent upon periods of superabundant food, while the remaining species maintain populations roughly proportional to the volume of foliage of the type in which they normally feed. There are differences of feeding position, behavior, and nesting date which reduce competition. These, combined with slight differences in habitat preference and perhaps a tendency for territoriality to have a stronger regulating effect upon the same species than upon others, permit the coexistence of the species.

379

MacArthur, R.H.;
On the breeding distribution pattern of North American migrant birds.
Auk. 76:318-325 1959

KEYWORDS: breeding distribution pattern;migratory birds;vegetation characteristics;climate;latitude;North America

ABSTRACT: Over a variety of undisturbed habitats throughout the continent, the density of breeding individuals of species migrating to the Neotropics seems to correlate with the contrast between winter and summer food supply in the given habitat. In the undisturbed northern habitats considered, the average migrant to the Neotropics is commoner than the average species which fails to make this journey. The reverse is true in the southern habitats.

380

MacArthur, R.H.;
Environmental factors affecting bird species diversity.
American Naturalist 98: 387-397. 1964

KEYWORDS: avian diversity;bird-habitat relationships;breeding birds;forest structure;diversity indexes;species-area census;Arizona USA

ABSTRACT: 1) Within homogenous habitats, the number of layers of vegetation is sufficient to account for the diversity of breeding bird species. When the area includes such major differences as those between patches of deciduous and coniferous forest, or sparse and dense vegetation, then the number of layers of vegetation is no longer sufficient to account for bird species diversity. 2) Point censuses of breeding birds make possible a separation of bird species diversity into vertical, horizontal and temporal components. In areas large enough to support 20 pairs of all species combined, the horizontal diversity seems to be independent of the number of layers vegetation. This needs more substantiation. 3) The slope of species-individuals curves enables us to estimate the number of environmental dimensions, the variation in which causes the increased number of species as more and more individuals are sampled. 4) The increased tropical bird species diversity seems to be primarily vertical or horizontal and has little large scale temporal component.

381

MacArthur, R.H.; Horn, H.S.
Foliage profile by vertical measurements.
Ecology 50: 802-804. 1969

KEYWORDS: technique: habitat assessment;forest structure;foliage profile;vertical measurements

ABSTRACT: A technique is described for estimating a foliage profile in a forest by a combination of measurements over random lines of points: (1) counts of leaf contacts on a plumb line below a tripod, (2) sightings on the heights of lowest leaves grids of points, and (3) the proportions of sky unobscured by leaves.

382

MacArthur, R.H.; MacArthur, J. W.
On bird species diversity.
Ecology 42:594-598 1961

KEYWORDS: avian communities;avian diversity;bird-habitat relationships;forest structure;forest diversity;U.S.A.

ABSTRACT: "Bird censuses on a wide variety of areas are compared in order to see what aspects of environmental variation control bird species diversity. In deciduous forests, bird species diversity can be predicted in terms of the height profile of foliage density. Plant species diversity, except by influencing this profile, has nothing to do with bird species diversity. The layers 0-2 feet, 2 feet to 25 feet, greater then 25 feet seem equally important in determining bird species diversity; these layers presumably correspond to different configurations of foliage. This should not be interpreted as evidence that a forest is made up of discrete layers. These 3 layers are constructed by the observer. An evolutionary argument is given which predicts the observations and at the same time suggests that niches should be 'convex.' Supporting evidence is provided. These results provide no evidence about the real caused of tropical diversity (i.e. whether the temperate regions, given enough time, can support as great a diversity as the tropics now have) or about the diversity which could be expected in a composite census of 2 habitats. These are essentially different problems and are under investigation now.

383

MacArthur, R.H.; MacArthur, J.W.;Preer, J.
On bird species diversity. II. Prediction of bird census from habitat measurements.
Am. Nat. 96:167-174 1962

KEYWORDS: avian diversity;habitat correlation;habitat measurements;foliage structure;census prediction

ABSTRACT: A fairly accurate census of breeding birds can be predicted from measurements of the amounts of foliage in three horizontal layers. The abundance of each species is roughly determined by the number of patches of vegetation whose foliage profile is acceptable to that species. This suggests that many species are rare only because their chosen foliage profile is rare. The main reason on habitat supports more bird species than another is that the first has a greater internal variation in vegetation profile. A second reason is that a forest with vegetation at many heights above the ground will simultaneously support ground dwellers, shrub dwellers and canopy dwellers. With a few exceptions, the variety of plant species has no direct effect on the diversity of bird species. Comparable plotting of tropical bird requirements should disentangle three of the possible factors associated with the tropical increase in diversity.

384

MacArthur, R.H.; Recher, H.;Cody, M.
On the relation between habitat selection and species diversity.
Am. Nat. 100:319-325 1966

KEYWORDS: avian ecology;avian diversity;breeding birds;habitat selection;habitat structure;bird-habitat relationships;diversity indexes;Panama

ABSTRACT: Breeding bird censuses were made in Puerto Rico, Panama, and temperate United States, and a profile of foliage density was made for each. Using information theory formulae both diversity indices and measurements of difference between censuses and difference between habitats can be made. Based on these, the following can be verified directly from the data: 1) Puerto Rico has nearly as many bird species per layer as Panama and the temperate regions, but the Puerto Rican species appear to recognize fewer layers and certainly subdivide habitats much less. Thus different habitats are likely to have quite similar species in Puerto Rico, unlike Panama and temperate United States.

385

MacClintock, L.; Whitcomb, R.F.;Whitcomb, B.L.
Island biogeography and "habitat islands" of eastern forests. II. Evidence for the value of corridors and minimization of isolation in preservation of biotic diversity.
Am. Birds 31:6-12 1977

KEYWORDS: forest fragmentation;forest corridors;avian diversity;bird-habitat relationships;conservation implications;Maryland USA

ABSTRACT: *Censuses of four plots and supplemental observations in forests surrounding the plots suggest that most of the forest interior bird species characteristic of the region are able to breed in forest fragments as small as 35 acres. However, this is apparently only possible if the fragment is "subsidized" by a nearby major forest system. The results emphasize the requirement for preserves of large size and confirm the importance of minimal isolation and corridors connecting fragmented forest tracts for preservation of maximum biotic diversity.

386

MacDonald, J.E.;
A bird census in red pine plantations and mixed stands in Kirkwood township, Ontario.
Can Field-Nat. 79: 21-25. 1966

KEYWORDS: pine plantations;avian diversity;bird- habitat relationships;forest succession;avian succession;breeding birds;coniferous forest;mixed-wood forest;Ontario

ABSTRACT: The species and numbers of birds nesting in red pine plantations in Kirkwood Township, Ontario, was small compared with populations in adjacent mixed stands. Finches were most numerous in the red pine stands, with Vesper Sparrows, Chipping Sparrows, and Slate-colored Juncos predominating. Few birds nested in red pine stands with closed canopies and sparse cover.

387

MacKenzie, D.I.; Sealy, S.G.;Sutherland, G.D.
Nest-site characteristics of the avian community in the dune-ridge forest, Delta Marsh, Manitoba: a multivariate analysis.
Can. J. Zool. 60: 2212-2223. 1982

KEYWORDS: breeding birds;bird-habitat relationships;habitat selection;nest site characteristics;discriminant analysis;deciduous forest;Manitoba

ABSTRACT: Nest-site characteristics of nine birds species breeding in high densities in the dune-ridge forest at Delta Marsh, Manitoba, were analyzed using multivariate techniques. Varimax-rotated principal component analysis of the entire set of nest-site variables suggested partitioning of the data into nest-habitat and nest-tree subsets. Discriminant analysis of nest-habitat variables confirmed the ambiguous nature of species relationships in the factor analysis. Discriminant analysis of nest-tree variables identified three distinct groups of species, based primarily on vertical stratification. The existence of these groups and their memberships were supported by similar results derived from discriminant analysis of the entire nest-site data set. Within these groups, pairs of species showed sufficient similarity in nest sites to warrant detailed investigation.

388

MacKenzie, J.M.D.;
The encouragement of birds in commercial plantations with nest-boxes and other means.
Scott. For. 6:10-17 1952

KEYWORDS: nest-boxes;bird populations;cavity-nesting birds;commercial plantations

ABSTRACT: It is possible to increase the populations of hole breeders, resident and migrant, and of tree creepers, by the provision of nest sites, which must be properly made and erected. Numbers of other species can be increased by appropriate means but they are of less importance. Nest sites are thought to be the normal control, but after they are increased by boxes, the resultant populations are more vulnerable to other limiting factors. This allows of considerable elasticity in the degree of control actually exercised.

389

MacLellan, C.R.;
Woodpeckers as predators of the codling moth in Nova Scotia.
Can. Entomol. 91:673-680 1959

KEYWORDS: bird-insect relationships;woodpeckers;codling moth;foraging behaviour;Nova Scotia

ABSTRACT: *Analyses showed that woodpeckers were efficient predators of overwintering codling-moth larvae and exhibited intraspecific competition. Woodpeckers frequently reduced the pest population in orchards to a level where other natural control agents were able to prevent the succeeding generation from damaging the fruit to an uneconomical degree. The numbers of woodpeckers, which never exceeded four per location, were estimated in 33 orchards for the years 1954-58. Two methods of study, sight records and observation on signs of feeding activity, showed that these birds live in permanent feeding zones which vary in size according to the food available. In areas that undergo little or no physical change the numbers of woodpeckers may remain steady for several years.

390

MacWhorter, R.;
Silvicultural prescriptions for the management of bald eagle habitat within Eaton Butte Bald Eagle Management Area.
Pp. 61-73 In: Proceedings of the National Silviculture Workshop: Silviculture for all resources, Sacramento, California, May 11-14, 1987. USDA For. Serv. Timber Management, Wash., D.C. 1987

KEYWORDS: bald eagle habitat;habitat management;silvicultural treatments;thinning: precommercial;thinning: commercial;shelterwood;management implications

ABSTRACT: Habitat management within Bald Eagle Management Areas can be enhanced and improved through the utilization of silvicultural treatments. Existing stand conditions must be assessed prior to determining Management Area treatments. More important, however, is the need to develop guidelines and objectives to utilize during the decision making process for management of the existing stand conditions. Silvicultural treatments which have proven to be very successful are precommercial thinning, commercial thinning, and regeneration systems which include shelterwood. As with many silvicultural treatments, benefits are realized in the long term. When considering the benefits of silvicultural prescriptions within Bald Eagle Management Areas, given the guidelines, objectives, and length of rotations, the term "long term benefits" acquires a new definition - patience.

391

Maithani, G.P. ED., ;

Special issue on wildlife management.
Indian Forester 112:841-956 1986

KEYWORDS:

ABSTRACT: not reviewed

392

Mannan, R.W.;
Use of snags by birds, Douglas-fir region, western Oregon.
M.S. Thesis. Oregon State Univ., Corvallis. 114 p. 1977

KEYWORDS:

ABSTRACT: not reviewed

393

Mannan, R.W.;
Assemblage of bird species in western coniferous old-growth forests.
Pp. 357-368 in: R.M. DeGraaf, tech. coord. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: avian ecology;avian diversity;avian density;foraging guilds;coniferous forest;old-growth forests; review;forest management;logging;rotation period;management implications

ABSTRACT: A review of available literature revealed that bird species richness and total bird density varied considerably among assemblages of bird species in various forest types of old-growth timber. However, proportions of species and individuals in foraging and nesting guilds were similar. Among foraging guilds, the number of species and individuals in the tree-foliage-searching and ground-brush-foraging categories were most abundant. Among nesting guilds, coniferous-tree-nesting birds and hole-nesting birds comprised the greatest proportions of species and individuals. Changes is vegetation structure caused by timber management have a tremendous potential impact on assemblages of bird species. One change that may have a particularly strong impact is the elimination of older forest age classes. Several bird species appear to be negatively impacted on by the reduction of old-growth forests. Effects of altering natural assemblages of bird species upon forest systems are unknown, but it is conjectured that a reduction in the number of insectivorous birds may result in reduced stability. Management for high species richness or diversity, with little regard for high species richness composition is questioned. Intensive efforts directed at gaining information on wildlife in old-growth forests are advocated.

394

Mannan, R.W.;
Bird populations and vegetation characteristics in managed and old growth forests, northeastern Oregon.
Ph.D. Dissertation, Oregon State University, 74 p 1982

KEYWORDS: avian diversity;avian density;foraging guilds;bird-habitat relationships;habitat structure;old-growth forests;managed forests;management implications;conservation implications;Oregon USA

ABSTRACT: Populations of breeding birds, and structure and composition of vegetation were examined in managed and old growth mixed coniferous forests in northeastern Oregon. Forest stands examined were approximately 85 and over 200 years of age, and were dominated by Douglas-fir and ponderosa pine trees. Components of vegetation that distinguished old growth forests from managed forests included large trees (51 + cm dbh) and snags (31 + cm dbh), small understory grand fir trees (2.5-10 cm dbh), and tree height diversity. Each of these components could be associated either directly or indirectly with differences in bird populations between managed and old growth forests. Bird species diversity and vertical and horizontal structural diversity of vegetation were greater in old growth forests than in managed forests; thus, our results supported the contention that bird species diversity is correlated with vegetation 'patchiness'. However, the usefulness of correlations between avian diversity and vegetation structure for management purposes is questioned. Managed forests supported a higher total density of breeding birds than old growth forests due to the abundance of several species that appeared to prefer structurally open habitats. Total density and species richness of birds in guilds (based on general location of foraging and nesting) differed between managed and old growth forests. However, consistent responses (in terms of density) among bird species within guilds did not exist. If remaining old growth forests are eliminated from areas under intensive management for timber in northeastern Oregon, some species of birds will increase in density, some will decrease, and a few may be extirpated on a region wide basis. Methods of maintaining habitat for those species that will decline in density following removal of old growth forests are suggested.

395

Mannan, R.W.; Meslow, E.C.
Census techniques for nongame birds.
Pp. 181-196. In: F.L. Miller, A. Gunn and S.R. Hieb, eds. Symposium on Census and Inventory Methods for Population and Habitats, Northwest Section The Wildlife Society, Proceedings. Forest, Wildlife and Range Experiment Station, Univ. Idaho, Moscow, Idaho. Contribution No. 217 1981

KEYWORDS: census techniques;nongame birds;abundance estimates;abundance indexes

ABSTRACT: **This paper reviews methods for censusing nongame birds. Methods for estimating abundance include: (1) spot-map method; (2) active nest density; (3) strip-census method; (4) sample count method; (5) variable width transect method; (6) Finnish transect method; (7) variable circular plot method. Methods used to index the abundance of birds include: (1) winter bird census method, which is similar to the spot-map method; (2) an index based on transect counts; and (3) the station index method. No standard method exists against which the accuracy of various methods can be assessed. All methods are inaccurate and deficient to various degrees with indicies being limited in applicability and information value. Thus it is difficult to recommend the use of one method over another.

396

Mannan, R.W.; Meslow, E.C.
Bird populations and vegetation characteristics in managed and old-growth forests, northeastern Oregon.
J. Wildl. Manage. 48: 1219-1238. 1984

KEYWORDS: managed forests;old-growth forests;forest structure;bird-habitat relationships;snags;understory;discriminant function analysis;management implications;mixed-coniferous forests;Oregon USA

ABSTRACT: Populations of breeding birds and structure and composition of vegetation were examined in managed and old-growth mixed-coniferous forests in northeastern Oregon. Forest stands were about 85 and over 200 years old and were dominated by Douglas-fir and ponderosa pine. Components of vegetation that distinguished old-growth forests from managed forests included the numbers of large trees (51 + cm dbh) and snags (31 + cm dbh) small understory grand fir trees (2.5-10 cm dbh), and tree height diversity; mean values of all these components were greater in old-growth forests. Three of these variable could be associated, either directly or indirectly, with major differences in bird populations between managed and old-growth forests. The abundance of large cnags in old-growth forests was probably responsible, in part, for the relatively high numbers of red-breasted nuthatches, and most other hole-nesting birds observed in this habitat. Large trees were indirectly important to hole-nesting birds because they provided a source of large snags. Grand fir trees were used by Townsend's warblers and golden-crowned kinglets when foraging and nesting, and we attributed the abundance of these two bird species in old-growth forests to the presence of this understory tree component. Species of birds that were more abundant in managed forests than in old-growth forests appeared to be attracted to the open structure of the managed stands. We discuss the effects of replacing old-growth forests with managed forests on bird species in northeastern Oregon. Methods of maintaining habitat for those species that will decline in density following the removal of old growth are suggested.

397

Mannan, R.W.; Meslow, E.C.;Wight, H.M.
Use of snags by birds in douglas-fir forests, western Oregon.
J. Wildl. Manage. 44: 787-797. 1980

KEYWORDS: snag use;forest age;cavity-nesting birds;avian diversity;avian density;bird-habitat relationships;management implications;Douglas-fir forest;Oregon USA

ABSTRACT: Use of standing dead trees by birds was investigated in the Douglas-fir region of western Oregon in spring and summer, 1975 and 1976. Snags were examined in forests approximately 10, 35, 75, 110, and 200+ years of age. Use of snags was quantified on the basis of evidence of past and present use by hole nesting birds. On the average, hole-nesting birds used Douglas-fir snags over 60 cm dbh and over 15 m tall for foraging and nesting; these snags usually had broken tops, few or no branches, decayed sapwood and heartwood, and less than 100% bark cover. Snags of this size and type occurred primarily in forests over 110 years of age; consequently, use of snags by hole nesting birds was concentrated in older forests (>110 years of age). Bird censuses were conducted in one representative area from each forest age-class. Density and species diversity of hole nesting birds increased with forest age. Density of hole-nesting birds was positively correlated ($r=0.98$, $P<0.05$) with mean dbh of snags. Intensive management of Douglas-fir forests does not allow for the production or retention of large snags. A reduction in the number of large snags could reduce populations of hole-nesting birds. Possible means for retaining and producing large snags are discussed.

398

Manuwal, D.A.; Munger, G.
The effect of timber harvest on bird populations in the Douglas fir forests of Washington State.
Prepared by the University of Washington, College of Forest Resources, Seattle, Washington. Final Report to US For. Serv. 102 p. 1978

KEYWORDS: logging;thinning;silvicultural treatment;fire;forest succession;avian diversity;avian density;post-logging responses;post-fire responses;bird-habitat relationships;Douglas fir forest;Washington USA

ABSTRACT: **The impact of forest management on forest bird populations was examined in this study. The logging history and forest management of the area are described, as is post-logging forest succession. The avifauna associated with forest succession stages is summarized. The effects of various forestry practices on avian species are discussed. Of 54 selected species, 32 will be enhanced by clearcutting-these are nearly all species that prefer early successional stages. Eleven species are expected to decline following clearcutting, 8 being cavity-nesters. Thinning would have a positive effect, though mediated by a shortened rotation period. The replacement of deciduous stands with pure conifer stands would cause a loss of avian species associated with the deciduous stands.

399

Marcot, B.G.;
Snag use by birds in Douglas-fir clearcuts.
Pp. 134-139 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: avian ecology;avian diversity;avian abundance;clearcutting;snags;cavity-nesting birds;management implications

ABSTRACT: In Douglas-fir clearcuts in northwestern California, bird species richness (mean number of species) and detection rates (mean number of birds of all species recorded per 10-minute count) were significantly greater in grass/forb and early brush/sapling stages where snags were present compared to where snags were absent. Mean detection rates and percent occurrence at count points of five primary and four secondary cavity nesters were significantly greater in clearcuts with snags compared with clearcuts without snags during breeding and post-breeding seasons. An exception was chestnut-backed chickadee. Most cavity-nesting species probably nested in adjacent, forested stands and used the clearcuts for foraging.

400

Marcot, B.G.;
Habitat relationships of birds and young-growth Douglas-fir in northwestern California.
Ph.D. Thesis. Oregon State Univ., Corvalis. 282 p. 1984

KEYWORDS:

ABSTRACT: not reviewed

401

Marcot, B.G.; Raphael, M.G.;Gerry, K.H.
Monitoring wildlife habitat and validation of wildlife-habitat relationships models.
Trans. North. Am. Wildl. Nat. Res. Conf. 48:315-329 1983

KEYWORDS: models;wildlife-habitat relationships;model validation;monitoring habitat

ABSTRACT: *Many resource agencies are developing information systems and models for predicting and monitoring wildlife through habitat relationships. Wildlife-habitat relationships (WHR) models are taking many forms, but a near-universal premise of the models is that distribution and abundance of wildlife species may be predicted from habitat components. We address the validation of WHR models by discussing 1) aspects of WHR models that lend to testing, 2) theory and criteria of model validation, 3) designing and conducting WHR validation studies, and 4) case studies of WHR models for monitoring purposes.

402

Marshall, P.B.;
Small bird populations and forest management practices in the Pacific Northwest.
Pp. 43-50 in: Proc. Fish and Wildl. Habitat Manage. Train. Conf. 1971

KEYWORDS:

ABSTRACT: not reviewed

403

Martin, N.D.;
An analysis of bird populations in relation to plant succession in Algonquin Park, Ontario.
Ecology 41:126-140 1960

KEYWORDS: forest succession;bird-habitat relationships;avian diversity;avian density;territory size;Ontario

ABSTRACT: *In order to determine some of the possible relationships between forest succession and bird populations in Algonquin Provincial Park, Ontario, censuses of breeding birds were taken, using the spot-map method, in most of the major forest types during the breeding season of 1952 and 1953. The approximate areas of the bird territories were measured and the vertical depth of territories determined by recording heights above the ground at which birds were observed. From these data approximations of average territory volume were obtained for a number of species. Niche characteristics of birds were recorded, and notes were made on aspection. In those plots having more diversified vegetation, and hence more niches, there were more bird species. There was some evidence of selection by birds primarily for deciduous or coniferous forest and secondarily for early or late stages of forest succession. Plots of mixed forest border had larger populations of birds than forest interior plots, due to more species being present rather than to larger representations of each species. Total bird populations per 100 acres were 286 territorial males of 13 species in bog, 232 territorial males of 32 species in boreal forest, 279 territorial males of 28 species in tsuga forest, and 168 territorial males of 18 species in hardwood forest.

404

Martin, T.E.;
Diversity and abundance of spring migratory birds using habitat islands on the Great Plains.
Condor 82: 430-439. 1980

KEYWORDS: shelterbelts;forest islands;avian diversity;avian density;bird-habitat relationships;migratory status;South Dakota

ABSTRACT: Relationships of area with numbers of species and individuals of spring migrants were examined for 69 shelterbelts (forest islands) in eastern South Dakota. Total abundance and number of species were as highly correlated with area during spring migration as during the breeding season. The relationship of area with total abundance and number of species were highly similar between two years of study. Area was more important in determining abundance and number of species than either diversity of plant species or isolation of the islands. The dispersion of migrants among islands, indicated by the relationships of area with total abundance and species numbers, could have been a result of passive dispersal, selection for larger area, or behavioral interactions. Passive dispersal was unlikely because the isolation of an island had no significant influence on abundance or diversity. Also, the diversity and abundance of migrants were modified by habitat conditions (i.e. vegetation diversity), indicating that migrants select the forest islands they inhabit. Migrants may select large areas but they should then have increased with area at an increasing rate, but this did not occur. Dispersion among islands may be the best way for migrants to replenish their energy reserves when food is scarce. Two facts suggest that migrants may interact to disperse themselves relative to food. First, application of a model for interacting species provided increasingly better fits to ecological groups that increasingly confined their foraging within shelterbelts. Second, the density of birds was greater in smaller islands than in larger islands owing to species that did not feed solely within the islands. The density of birds that did feed primarily within the islands remained more or less constant with changing area.

405

Martin, T.E.;
Habitat and area effects on forest bird assemblages: is nest population an influence?
Ecology 69: 74-84. 1988

KEYWORDS: habitat structure;forage size;forest birds;avian diversity;bird-habitat relationships;species-area;nest predation

ABSTRACT: The ability of nest predation to explain patterns of covariation in species numbers with area and habitat was examined for forest birds. Numbers of individuals and species of birds were counted in 23 drainages in high elevation (2300 m) forest in central Arizona for 3 years. Variation in bird species numbers was compared to variation in area habitat structure among drainages. Birds were grouped into foraging and nesting guilds based on heights and substrates used. Numbers of species increased with area for all guilds, but species-area slopes differed among nesting guilds. Differences in slopes cannot be explained by passive sampling because source pool size was the same or similar between guilds compared. Differences in slopes are consistent with a prediction that slopes should be greater for guilds that are more susceptible to nest production. Variation in numbers of species among drainages was positively correlated with a variation in the density of foraging and nesting substrates. However, correlations were greater when based on nesting than foraging heights and substrates. The results are consistent with a prediction that birds are selecting habitat sites based in part on the availability of nest sites that minimize risk of nest predation, and that these sites increase with density of foliage at nest height. These results are also consistent with a hypothesis that the availability of suitable nest sites is one of the bases for the relationship between species numbers and foliage density for foliage-nesting species. This conclusion is supported by a re-analysis of the data of Wilson (1974), where foliage-nesting birds were grouped into nest-height guilds using data from the Cornell Nest Record Program; more of the birds that were added with vegetation layers tended to nest in those layers than forage in them. In short, multiple activities (foraging and nesting) can allow multiple processes to act simultaneously.

406

Martin, T.E.; Karr, J.R.

Patch utilization by migratory birds: resource oriented?
Ornis. Scand. 17:165-174 1986

KEYWORDS: migratory birds;patch utilization;resource availability;foraging behaviour;site selection;avian abundance;Illinois USA

ABSTRACT: Use of gap (created by tree falls) and non-gap forest understory sites by migrating birds in central Illinois was studied during spring and autumn for three years (1978-1980). Fruit and understory foliage were concentrated in gaps. Birds that relied on these resources (foliage-gleaning insectivores, frugivores in autumn) used gaps more than non-gaps. Birds that fed on food other than fruit and foliage insects ("frugivores" in spring, other insectivores) did not use gaps more than non-gaps. Bird abundance varied markedly among gap and non-gap sites, potentially reflecting differences in site preferences. Site selection, as determined by bird abundances, was consistent (correlated) between years for birds that did not rely on these patchy resources. Foliage density is a measure of foraging substrates for foliage-gleaning birds to search. Abundance of foliage-gleaning insectivores was highly correlated with foliage density in both spring and autumn. Frugivore abundance was highly correlated with fruiting foliage density during autumn when they are frugivorous, but not during spring when they are insectivorous. Insectivores not relying on foliage insects or fruit were uncorrelated with either index of resource availability. These same relationships hold even when examining gap sites only. Thus, migrants can be consistent in their selection of foraging sites and this consistency appears to exit when resource densities are markedly different among sites (patchy) but not when resources are more dispersed.

407

Marzluff, J.M.; Lyon, L.J.
Snags as indicators of habitat suitability for open nesting birds.
Pp. 140-146 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: avian ecology;avian diversity;open-nesting birds;bird-habitat relationships;avian succession;forest succession;clearcuts;habitat suitability;snags: as indicators;management implications;Montana USA

ABSTRACT: The habitat requirements of open nesting birds were examined in 19, five hectare, plots arranged along an altitudinal gradient in western Montana. Seven, mature forest birds were examined in detail. Percent shrub and low canopy cover (0.5-1.5 m), mid-canopy cover (8-25 m), and the number of large diameter stems (25-50 cm dbh) were of major importance to this avian community. Increased avian diversity was associated with increased structural complexity of plots. Precise habitat recommendations for each species are proposed and related to more easily quantified snag variables. Management of western Montana forests to sustain production of 80 snags per hectare, preferably in a clumped distribution, will provide suitable habitat not only for cavity nesters, but also for sensitive open nesting species.

408

Maser, C.R.; Anderson, R.G.;Cromack, K. Jr.;Williams, J.T.;Martin, R.E.
Dead and down woody material
Pp. 78-95 in: J.W. Thomas, tech. ed. Wildlife habitats in managed forests: The Blue Mountains of Oregon and Washington. USDA For. Serv. Agric. Handbook 553. 1979

KEYWORDS: dead and down wood;wildlife habitat;forest ecology;forest management;fire: prescribed;mechanical manipulation;chemicals;management implications

ABSTRACT: **The importance of dead and down woody materials in forests as wildlife habitat is discussed in this chapter. As well, natural succession of dead and down wood and forestry practices which produce and eliminate these woods are covered. Several management guidelines for the retention of logs and slash as wildlife habitat are given.

409
Massey, C.L.; Wygant, N.D.
Woodpeckers: most important predators of the spruce beetle.
Colo. Field Ornithol. 14:4-8 1973

KEYWORDS: woodpeckers;spruce beetle;bird-insect relationships;insect predation

ABSTRACT: Woodpeckers are the most important predators of the spruce beetle. In some areas, they have destroyed as much as 75% of the beetle population. Three species frequently congregated to prey on spruce beetles, especially during beetle outbreaks, in Colorado: the Northern Three-toed Woodpecker, the Hairy Woodpecker, and the Downy Woodpecker.

410
Mathisen, J.E.;
Effects of human disturbance on nesting of bald eagles.
J. Wildl. Manage. 32:1-6 1968

KEYWORDS: Bald eagles;nesting activity;disturbances;timber harvest;recreational activities;Minnesota USA

ABSTRACT: Known nests of bald eagles on the Chippewa National Forest were divided into three groups reflecting degrees of isolation, called wilderness factors. The eagle nests under consideration were occupied 182 times from 1963-1966. The rate of occupancy was essentially the same for each group. Nests in the high wilderness-factor category were successful 54% of the time, in the moderate category 57%, and in the low category 48%. None of these differences are statistically significant, indicating that human activity at levels existing on the Chippewa is not an important source of disturbance and has no measurable effect on nesting success or nest occupancy. Most human activity around nest sites in this region occurred during the latter part of the nesting cycle when family ties were strongest. Habitat modified by timber management in the immediate vicinity of nest sites did not appear to affect nesting activity. Failure of eagles to produce young on the Chippewa must be related to some factor other than human disturbance.

411
Mathisen, J.E.;
Integrating wildlife habitat objectives with silvicultural prescriptions.
Pp. 23-27 in: T.W. Hoekstra and J. Capp, compilers. Integrating forest management for wildlife and fish. USDA For. Serv. NC-122 63p. 1988

KEYWORDS: silviculture;forest management;forest structure;avian communities;habitat requirements;management implications;Minnesota USA

ABSTRACT: Land managers need methods to assess, measure and predict the affects on wildlife of vegetation change resulting from silvicultural prescriptions. A data base was developed to relate vertebrates on the Chippewa National Forest to their habitats and special requirements, providing a simple method comparing alternative land use proposals in terms of species.

412
Mathisen, J.E.; Sorenson, D.J.;Frenzel, L.D.;Dunstan, T.C.
Management strategy for bald eagles.
Trans. N. Amer. Wildl. and Nat Res. Conf. 42:86-92 1977

KEYWORDS: Bald eagles;nest-tree characteristics;nest protection;management strategies;Minnesota USA

ABSTRACT: Existing bald eagle nest protection regulations prior to 1974 on the Chippewa National Forest were shown to be inadequate for some nests and territories. Since 1974, additional constraints and management actions have been implemented on the forest to improve eagle nest protection and to enhance bale eagle habitat and other forest resources. Important among these implementations has been the requirement of a detailed management plan for those forest areas in which eagle nests occur. Development and applications of management plans have proven of considerable value in confronting the complex and varied problems associated with land management on the Chippewa National Forest. Careful integration of forest and bale eagle management has resulted.

413

Maurer, B.A.; McArthur, L.B.;Whitmore, R.C.
Habitat associations of birds breeding in clearcut deciduous forests in West Virginia.
Pp. 167-172 in: D.E.Capen, ed. The Use of Multivariate Statistics in Studies of Wildlife Habitat. USDA For. Ser. Gen. Tech. Rep. RM-87. 1981

KEYWORDS: habitat assessment;post-logging response;breeding birds;bird-habitat relationships;vegetation structure;clearcut;deciduous forest;habitat ordination;principal component analysis;West Virginia USA

ABSTRACT: Associations between vegetation structure and 34 bird species in four forested areas of various stages of clearcut regrowth were examined using principal components analysis. Relative frequencies for each bird species were determined during three breeding seasons and used to weight habitat variables. The resulting data matrix (34 species x 8 habitat variables) was subjected to principal components analysis using a standardized covariance matrix. The first principal component was negatively correlated with percent and mean height of low vegetation, and positively correlated with percent litter and the number, height, and percent of canopy layers. The first principal component separated early successional species from late successional species. The second principal component was positively correlated with percent slash and the number of trees less than 12.7 cm dbh. This component separated mid-successional species from earlier and later successional species. The first two components explained 90% of the variation and thus seemed to be an adequate description of the habitat associations of most species. The third component, however, was useful in separating a few of the mid-successional species, with species that foraged mainly on the ground having higher values than species that foraged on small trees and shrubs. The third component was positively correlated with percent litter and negatively correlated with the number of trees less than 12.7 cm dbh. Field methods used in this study appear to be most applicable where it is impractical to use more conventional methods of collecting habitat association data, e.g., territory mapping, or use of male singing perches.

414

Maurer, B.A.; McArthur, L.B.;Whitmore, R.C.
Effects of logging on guild structures of a forest bird community in West Virginia.
American Birds 35: 11-13. 1981

KEYWORDS: forest structure;clearcutting;selection cut;post-logging responses;foraging guilds;avian diversity;deciduous forest;West Virginia USA

ABSTRACT: In assessing the impact of habitat alterations on a bird community it is essential to understand what effect altering vegetation structure will have within a bird community. As the bird community changes and certain species are lost they are not replaced by new species on a "one for one" basis. Rather as the vegetation structure is altered the relative abundance of each guild in the bird community changes. In addition to inter-guild changes, there are changes intra guilds. Therefore, since purposeful manipulations of the habitat with the intention of favoring a selected species will affect guilds within the bird community, management options which alter vegetation structure should be assessed from a community perspective.

415

Mawson, J.C.; Thomas, J.W.;DeGraaf, R.M.
Program HTVOL: the determination of tree crown volume by layers.
USDA For. Serv. Res. Paper NE-354. 1976

KEYWORDS: bird-habitat relationships;forest structure;techniques: modelling

ABSTRACT: A FORTRAN IV computer program calculates, from a few field measurements, the volume of tree crowns. This volume is in layers of a specified thickness of trees or large shrubs. Each tree is assigned one of 15 solid forms, formed by using one of five side shapes (a circle, an ellipse, a sigmoid, a triangle, or a parabolalike shape), and one of three bottom shapes (a circle, an ellipse, or a triangle). A test of accuracy of this technique shows that it produces estimates within acceptable limits of error if the shape is carefully selected. The program sorts these volume data by layer within species for each sample plot. Any number of plots can be run at one pass through the computer, and up to 100 species can be designated.

416

MCARTHUR, L.B.; Whitmore, R.C.
Passerine community composition and diversity in man-altered environments.
West Virginia Forestry Notes, West Virginia University. No. 7:1-12 1979

KEYWORDS:

ABSTRACT: not reviewed

417

McCambridge, W.F.; Knight, F.B.
Factors affecting spruce beetles during a small outbreak.
Ecology 53: 830-839. 1972

KEYWORDS: spruce beetle;spruce beetle outbreaks;coniferous forest;Colorado USA

ABSTRACT: In 1957, spruce beetles developed into outbreak numbers in logging slash at a north-central Colorado site, entered living spruce trees, but remained epidemic for only two years. Reduced beetle fecundity was the first indication of outbreak decline; this was caused by nematodes and unknown agents. Significant summer mortality agents were pitch, intra- and interspecific competition for food, predation by woodpeckers and flies, and parasitism by wasps. Desiccation of both food and beetles larvae, enhanced by woodpecker feeding activity, contributed significantly to outbreak decline. Winter mortality was attributed mainly to woodpeckers, although temperature -29 C caused additional losses. The effects of the outbreak on the spruce was considerable. Large diameter trees in small patches were killed, and species composition was altered in favour of subalpine fir and lodgepole pine, but mean tree diameter was not significantly reduced.

418

McClelland, B.R.;
Relationships between hole-nesting birds, forest snags, and decay in western larch-Douglas fir forests of the Northern Rocky Mountains.
Ph.D. Thesis, Univ. Montana, Missoula, 489 pp. 1977

KEYWORDS: cavity-nesting birds;bird-habitat relationships;snags;cavity tree characteristics;decay;indicator species: pileated woodpecker;timber harvest;management implications;western larch-Douglas fir;Montana USA

ABSTRACT: Nest tree and nest site preferences of hole-nesting birds were studied in the western larch-Douglas-fir forest cover type of northwestern Montana. The objectives of the study were to: 1) locate and characterize active nest trees, 2) identify habitat characteristics which have a major influence on the density and distribution of hole-nesting birds, and 3) provide management recommendations. Three hundred and ten active nests were located, primarily by following vocalizations and flight paths. Twenty bird species (nine of which were woodpeckers) and 14 tree species were represented. Fifty-two percent of the nest trees (all species) were snags; 48 percent were live trees (79 percent of which had broken or dead tops). Preference for broken-top western larch was highly significant ($P<0.01$). With few exceptions larch nest trees were infected with heartwood decay caused by Fomes larcis of F. pini. Larch nest trees averaged 26.4 inches dbh (67.1 cm), and were typically old (>200 years). Douglas-fir is the most common tree on many sections of the study area but is not a preferred nest tree because snag decay progresses rapidly and soon involves sapwood. In contrast, western larch heartwood decay progresses slowly and the sapwood remains relatively unaffected for many years, providing a firm shell around softened heartwood. The Yellow-bellied Sapsucker is the most common woodpecker in the study area. The Pileated Woodpecker is the most sensitive to timber cutting practices and can be considered an indicator taxon. A pair of this species uses a feeding territory of 500-1000 acres. Pileated Woodpeckers and Yellow-bellied Sapsuckers are "path-finders", usually excavating new nest cavities each spring; abandoned cavities are then available for use by hole nesters incapable of excavation. Optimum habitat for most hole nesters is old-growth larch on productive sites, particularly near wet areas. Management recommendations presented include identifying old-growth stands to be managed by reservation or selective cutting and long rotations (>300 years); maintenance of snags in patches rather than simply by a snag per acre rule; and incorporating habitat needs for hole nesters at an early stage in unit planning.

419

McCelland, B.R.;
Influences of harvesting and residue management on cavity-nesting birds.
Pp. 469-496. in: Environmental consequences of timber harvesting in Rocky Mountain coniferous forests. Symp. Proc., Sept. 11-13, 1979, Missoula, Montana. USDA For. Serv. Gen. Tech. Rept. INT-90. 1980

KEYWORDS: cavity nesting birds;old-growth;clearcuts;residue removal;bird-habitat relationships;post-logging responses;avian diversity;avian density;foraging behaviour;nest sites;management implications;larch:western;Montana USA

ABSTRACT: Coram Experimental Forest (CEF) plots on which different harvesting prescriptions and residue utilization intensities were applied in 1974 were studied during 1974-1979 to determine impacts on nesting and feeding activities of cavity nesters, especially woodpeckers. Uncut controls on the CEF and on other sites in the Flathead National Forest and Glacier National Park also were studied. Cavity nesters preferred western larch, ponderosa pine, black cottonwood, paper birch, or aspen nest trees with heartwood decay. Forests with a component of old-growth western larch supported the highest density and diversity of cavity nesters. Uncut controls received the highest % of feeding use. Shelterwood cuts and uncut islands within group selection plots received relatively high feeding use. Clearcuts received little use, regardless of the intensity of residue utilization.

420

McCelland, B.R.; Frissell, S.S.
Identifying forest snags useful for hole-nesting birds.
J. of Forestry 414-417 1975

KEYWORDS: snags;snag management;cavity-nesting birds;bird-habitat relationships;cavity-tree characteristics;management implications;mixed-wood forest;Montana USA

ABSTRACT: Preliminary results of a Montana study in western larch and Douglas-fir forests indicate that large broken-top larch and paper birch are most useful as nesting habitat. Some tentative management guides are suggested.

421

McCelland, B.R.; Fissel, S.S.;Fischer, W.C.;Halvorson, C.H.
Habitat management for hole-nesting birds in forests of western larch and Douglas-fir.
J. For. 77: 480-483. 1979

KEYWORDS: cavity-nesting birds;avian diversity;avian density;habitat selection;snags;snag management;management implications;coniferous forest;Montana USA

ABSTRACT: During a 3-year study in western larch Douglas-fir forests of northwestern Montana, 273 active nest trees of 20 hole-nesting bird species were located. Stands with major components of old-growth western larch, ponderosa pine, or black cottonwood supported the highest density and diversity of hole-nesters. On commercial forests, managers should maintain units of old growth and prepare silvicultural prescriptions that will provide continuing replacement in the future.

422

McCluskey, D.C.; Thomas, J.W.;Meslow, E.C.
Effects of aerial applications of DDT on reproduction in house wrens and mountain and western bluebirds.
USDA For. Serv. Res. Pap. PNW-228. Pac. Northwest For. and Range Exp. Stn., Portland, Oregon. 22 pp. 1977

KEYWORDS: pesticides: effects of;breeding birds;passerines;cavity-nesting birds;resident birds;Oregon USA

ABSTRACT: No significant adverse effect on reproductive success of mountain bluebirds, western bluebirds, and house wrens was detected after aerial application of DDT at a rate of 0.84 kilogram per hectare. The 2-year study determined the fate of 656 eggs within the spray area and 711 eggs within the control areas.

423

McComb, W.C.;
Nest box and natural cavity use by wildlife in mid-south hardwoods as related to physical and microclimatic characteristics.
Ph.D. Thesis, Louisiana State Univ., Baton Rouge. 228 pp. 1979

KEYWORDS:

ABSTRACT: not reviewed

424

McComb, W.C.; Bonney. S.A.;Sheffield, R.M.;Cost, N.D.
Snag resources in Florida - are they sufficient for average populations of primary cavity-nesters?
Widl. Soc. Bull. 14: 40-48. 1986

KEYWORDS: cavity-nesting birds;snag management;snags;bird-habitat relationships;management implications;Florida USA

ABSTRACT: Estimated densities of primary cavity-nesters were positively associated (r=0.71) with cover types. A surplus of 4-9 snags/primary cavity-nester is recommended. For average potential populations of primary cavity-nesters in Florida, at least 120 > or equal to 12.7-cm snags/40 ha, 84 > or equal to 25.0-cm dbh snags/40 ha, and 8 > or equal to 50-cm snags/40 ha should be available.

425

McComb, W.C.; Muller, R.N.
Snag densities in old-growth and second-growth Appalachian forests.
J. Wildl. Manage. 47: 376-382. 1983

KEYWORDS: snags;forest structure;cavity-tree characteristics;old-growth forest;second growth forest;hardwood forest;Kentucky USA

ABSTRACT: Snag densities were compared among 3 forest communities in each of a virgin and a 35-year-old 2nd-growth mixed hardwood stand in eastern Kentucky. Snags <15.o cm dbh were more abundant in the 2nd-growth than in the old-growth stand, but there was no difference in the density of the snags > ur equal to 15 cm dbh between the stands. Density of snags > 10 cm dbh was higher in the forest community dominated by the chestnut oak and red maple than in the forest community dominated by American beech. Black locust, flowering dogwood, and white sassafras were more prone to formation of snags > 10 cm than were red maple, American beech, or red oaks. A 35-year-old clear-cut provided some characteristics of suitable pileated woodpecker habitat (36-60-cm-dbh trees, 25-28-square metres/ha basal area, and > 430 trees/ha), but other factors may affect habitat quality for cavity-nesting birds.

426

McComb, W.C.; Noble, R.E.
Effects of single-tree selection cutting upon snag and natural cavity characteristics in Connecticut.
Trans Northeast. Sect., The Wildl. Soc., Fish and Wildl. Conf. 37:50-57 1980

KEYWORDS: single-tree selection;forest characteristics;snags;cavity-tree characteristics;management implications;Connecticut USA

ABSTRACT: A comparison of characteristics of sound trees, snags, cavity bearing trees and tree cavities in an unmanaged stand to those characteristics in a stand managed under the single-tree selection system since 1913 was conducted in Dec. 1978. We found differences between areas in forest type, crown density, basal area, tree density, snag density, density of squirrel leaf nests, bark cover of cavity trees, tree dbh, tree height, snag height, number of dead limbs per tree, number of limbs per snag, condition of top of snags, height of cavities, orientation of cavity entrances and frequency of cavities under limbs. Recommendations include deadening of cull trees, retention of several large diameter trees per ha and care around snags during harvest.

427

McComb, W.C.; Rumsey, R.L.
Characteristics and cavity-nesting bird use of picloram-created snags in the central Appalachians.
South J. Appl. For. 7: 34-37. 1983

KEYWORDS: cavity nesting birds;herbicides: effects of;snag management;cavity-tree characteristics;management implications;mixed-wood forest;Kentucky USA

ABSTRACT: A soil-applied herbicide rate of 40 lb/acre TORDON 10K created snags (dead trees) and/or habitat characteristics desirable for foraging and nesting cavity-nesting birds in eastern Kentucky. Integration of picloram pellet application into TSI programs would allow quality improvement and a sustained supply of potential feeding and nesting sites for cavity-dependent birds.

428

McCoy, E.D.;
The application of island-biogeographic theory to forest tracts: problems in the determination of turnover rates.
Bio. Conserv. 22:217-227 1982

KEYWORDS: forest size;avian communities;avian diversity;migratory status;avian turnover;biogeography;conservation implications

ABSTRACT: Any change in the species-composition of birds on 'islands' may be described potentially by a number of models, one of which is the equilibrium island biogeographic model. The proper application of the equilibrium model requires that several conditions be met; the most important of which are: (1) the ability to identify true 'colonists'; (2) balanced immigration and extinction rates; and (2) no large-scale environmental alterations causing changes in species-composition between sampling intervals. Failure to meet such conditions may lead to improbable or unrealistic interpretations of species change within the context of equilibrium island biogeographic theory. This problem is illustrated with some recent data on birds residing in a small forest patch. When the theory is used to determine the design characteristics of faunal reserves, the entire matter takes on added significance. Ecological justification for the preservation of large, contiguous areas cannot be gained from the equilibrium model. In addition, predictions of the model are virtually useless without an accompanying body of autecological information on the species intended to be preserved.

429

McGarigal, K.; Fraser, J.D.
The effect of forest stand age on owl distribution in southwestern Virginia.

J. Wildl. Manage. 44:1393-1398 1984

KEYWORDS: great horned owl;barred owl;habitat selection;mature stands;management implications

ABSTRACT: *The influence of stand age on great horned owl and barred owl distributions were investigated by testing the hypothesis that these species respond to tape recorded vocalizations with equal probability at young (<=80 years old) and old (>80 years old) forest stands. Both owl species responded more frequently at old stands than at young stands. The reason for the apparent preference for mature stands are not clear, though plausible hypotheses are: (1) owls may require large trees found in mature stands for nest cavities or to hold stick nests and (2) owls must be able to move through a timber stand unimpeded by branches and other obstructions. Great horned owls exhibited a preference for stands near farmland, this association likely being related to food habits. Because both owl species responded less frequently at young than old stands, intensive timber management in which most stands are cut at 80 years of age may cause declines in owl populations.

430

McLellan, C.H.; Dobson, A.P.;Wilcove, D.S.;Lynch, J.F.
Effects of forest fragmentation on New and Old World bird communities: Empirical observations and theoretical implications.
Pp. 305-313 in: J. Verner, M. Morrison and C.J. Ralph, eds. Wildlife 2000: modeling habitat relationships of terrestrial vertebrates. Univ. Wisconsin Press, Madison WI. 1986

KEYWORDS: forest fragmentation;forest size;bird-habitat relationships;avian ecology;avian diversity;technique: habitat assessment;modeling;area-sensitive species;species-area curves;extinctions;conservation implications

ABSTRACT: The effects of forest fragmentation on the bird communities of England and the United States are considered, using complementary sets of empirical data. Nomograms for both countries reveal that a series of small reserves will contain more species than a single large reserve of the same total area, but that the large reserves are needed to preserve a number of area sensitive species. A simulation model is then presented to illustrate the key effects of fragmentation on the species pool of an originally contiguous habitat. The model suggests that extinctions of species are initially low, but increase rapidly once a critical percentage of the original habitat has been destroyed. This percentage depends crucially upon both the territory sizes and dispersal abilities of the species pool under consideration. We then discuss how the optimum conservation strategy for preserving woodland birds will depend upon the number of area sensitive species, the slope of the species area curves, and the extent to which the habitat has already been fragmented. We conclude by discussion the work's more general implications for conservation policymakers on a variety of different geographic, taxonomic, and administrative scales.

431

McNeil, R.;
Winter resident repeats and returns of austral and boreal migrant birds banded in Venezuela.
J. Field. Ornithol. 53:125-132 1982

KEYWORDS: boreal migrant birds;biogeography;wintering habitat;fidelity;Venezuela

ABSTRACT: *Repeats and recaptures of austral (2 species of Elaenia flycatchers) and boreal (2 species of shorebirds and 3 species of warblers) migrant birds banded in northeastern Venezuela are discussed in terms of fidelity to wintering sites during the same winter and from one winter to the next. Austral migrants also seem to move to more favorable areas in food shortage years.

432

Mealy, S.P.; Horn, J.R.
Integrating wildlife habitat objectives into the forest plan.
Trans. N. Amer. Wildl. and Nat. Resour. Conf. 46:488-500 1981

KEYWORDS: integrating management;wildlife habitat;forest management;linear programming model;indicator species;accipiters

ABSTRACT: Wildlife habitat objectives for the coniferous forest community were integrated into the Arapaho and Roosevelt National Forests Forest Plan using linear programming (LP) resource allocation model. Objectives specified proportions of forest successional stages, and numbers of residual trees per acre by size class, to maintain viable populations of all wildlife species, to maintain and improve habitat for management indicator species (MIS), and to provide for diversity of animal communities on a sustained yield basis. Objectives for special and unique habitats and spatial relationships were provided for "outside" the LP. Objectives were stated as minimum standards and optimum conditions. Minimum standards for lodgepole pine were: (1) grass/forb/shrub: high range <= 20%; low range > present, if present is < 20%; (2) mature: 20% + 5; and (3) old growth or vertical diversity: >= 20%. In continuous stands of lodgepole pine, optimum conditions were 16% for the following stages: grass/forb/shrub, seedling/sapling, pole, young, and mature. The optimum condition for old growth or vertical diversity was 20%. Minimum standards served as constraints in the LP and provided minimum acceptable wildlife habitat conditions under all multiple use management intensities. Optimum conditions served as goal equations in the LP and provided direction for improving wildlife habitat conditions above minimum acceptable levels. Objectives were based on habitat requirements of elk, representing early forest succession MIS, and the three accipiters: goshawk, sharp-shinned hawk, and Cooper's hawk representing late forest succession MIS. Elk were represented because of large space and food needs. Accipiters were represented because of large space needs and nesting and foraging requirements. It was assumed that objectives meeting needs of species with restrictive habitat requirements would also accommodate needs of MIS with similar but less restrictive requirements. Two linked LPs, one driving the other, were used in allocating and scheduled optimum resource outputs on a Forestwide basis. An auxiliary model reallocated and scheduled the Forestwide solution to discrete ecological units on the basis of site-specific habitat needs. The timber harvest schedule was responsive to wildlife habitat objectives. Over the 50-year planning period the models forced habitat structure to move incrementally toward optimum conditions while maintaining minimum standards for wildlife and all other resources. Early forest successional stages were increased in watersheds where mature or overmature timber predominated. Late forest successional stages were increased in watersheds where timber harvest has been concentrated.

433

Medin, D.E.;
Densities and nesting heights of breeding birds in an Idaho Douglas-fir forest.
Northwest Science 59: 45-52. 1985

KEYWORDS: avian density;bird-habitat relationship;breeding birds;cavity-nesting birds;foraging behavior;coniferous forest;Idaho USA

ABSTRACT: Population densities and nesting heights of breeding birds are described for an unlogged Douglas-fir forest in west-central Idaho. Bird populations were determined using spot-mapping techniques on six 8.1 ha plots from mid-May to late July, 1976 through 1979. Nests were located incidental to bird censuses and by additional day long searches. Bird populations ranged from 192 to 252 breeding pairs per 40 ha, 18 to 21 species were territorial. Standing crop biomass ranged from 189 to 237 g/ha. Also summarized are heights, substrates, and placement of 204 nests, representing 25 species. The most important nesting height strata in the Douglas-fir forest were the understory layer, with over 40 percent of the breeding bird population, and overstory layer with about 30 percent of the population. The ground, shrub, and midstory layers each accounted for about a tenth of the total nesting avifauna. Densities and other features of the breeding bird community are compared with the data from the Douglas-fir forests elsewhere in North America.

434

Medin, D.E.;
Breeding responses to diameter-cut logging in west-central Idaho.
USDA For. Serv., Interm. Res. Stat., Res. Paper INT-355. 12 pp 1985

KEYWORDS: diameter-cut logging;post-logging responses;avian diversity;avian density/biomass;foraging guild;nesting guild

ABSTRACT: Populations of breeding birds responded differently to structural changes in a Douglas-fir forest caused by diameter-cut logging. Little change occurred in total bird density or standing crop biomass of birds either between years or between logged and unlogged plots. But there were pronounced changes in the composition of the breeding bird community. Logging the forest resulted in increases in numbers for species that require more open habitats and decreases in populations for species that require more closed habitats. Several species maintained relatively stable densities on both logged and unlogged plots. The number of breeding bird species (species richness) was consistently higher on logged plots than on unlogged plots and trended upward each year after logging. Ten species were territorial only in the logged forest. One species that was territorial in the unlogged forest was absent from the logged forest. There were no clear patterns in bird species diversity either between years or between logged and unlogged plots. The evenness (equitability) component of bird species diversity declined each year after logging. Two categories (guilds) of birds - the foliage foragers and the timber gleaners - were less numerous on logged plots. The timber-gleaning guild, the most severely affected, dropped to only one-third of prelogging densities in the third year after logging. The ground-foraging and flycatching guilds were more numerous on logged plots. Of nine species represented in the ground-foraging guild, each was proportionately more abundant in the logged forest than in the unlogged forest. The timber-drilling guild, at least in total, was a relatively stable component of the breeding bird population. Patterns observed in this study, and other studies that were compared, suggest consistencies of response among certain breeding bird species to logging in western coniferous forests.

435

Medin, D.E.; Booth, G.D.
Responses of birds and small mammals to single-tree selection logging in Idaho.
USDA For. Serv., Interm. Res. Stat., Res. Paper INT-408, 11pp 1989

KEYWORDS: single-tree selection;post-logging responses;avian diversity;avian density/biomass;foraging guilds;nesting guilds

ABSTRACT: Responses of birds and small mammals to logging depend on the cutting methods used and the degree to which forest stands are altered. This study examined short term changes in the composition and abundance of small mammals and breeding birds following single tree selection logging in an Idaho Douglas-fir forest. Populations of birds and small mammals were estimated on a logged plot and on a nearby unlogged plot from 1975 (2 years prelogging) to 1979 (3 years postlogging). Total numbers of breeding birds were relatively stable between years and between logged and unlogged plots. More pronounced patterns of response occurred in the populations making up the breeding bird communities. Species with positive numerical responses to the selection cut were olive-sided flycatcher, Swainson's thrush, yellow-rumped warbler, and chipping sparrow. Species with negative numerical responses to logging were red-breasted nuthatch and brown creeper. Fourteen other species showed little numerical response to the timber harvest. Birds that forage by gleaning the surface of the bark (timber gleaners) declined in number after logging. Foliage feeders, aerial-sally feeders, and timber drillers were about equally abundant before and after logging. The ground gleaning guild showed a slightly positive pattern of response. Of six nesting guilds represented, only the secondary cavity nesters were adversely affected by logging. Bush and small tree nesters tended to increase after timber harvest. Deer mice, yellow pine chipmunks, and boreal redback voles accounted for 93% of 8115 individual animals trapped during the study. Postlogging estimates of deer mice density were generally similar on both the logged and the unlogged plots. But when results were expressed as the mean number of individual animals trapped each year, significantly fewer deer mice were trapped on the logged plot. Numbers of yellow pine chipmunks increased on logged sites; it was the most commonly trapped small mammal in postlogging environments. No significant difference was found in the number of redbacked voles trapped in the cut and uncut forest. Other species were trapped irregularly and in smaller numbers.

436

Menasco, K.A.;
Providing snag habitat for the future.
Pp. 205-210 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: snag habitat;snag requirements;timber rotation;economics

ABSTRACT: Two green trees in addition to 1.8 snags should be adequate to maintain sufficient snag numbers during a timber rotation. If a sufficient number of snags are not present then snags must be artificially created or more green trees must be retained. The amount of timber volume lost to provide snag habitat will amount to 4 percent of the total volume.

437

Meslow, E.C.;
The relationship of birds to habitat structure - plant communities and successional stages.
Pp. 12-18 in: R.M. DeGraaf, tech. coord. Proceedings of the workshop on nongame bird habitat management in the coniferous forests of the western United States. USDA For. Serv. Gen. Tech. Rept. PNW-64. 1978

KEYWORDS: bird-habitat relationships;forest structure;forest succession;avian succession;avian diversity;forest management;silviculture;rotation period;even-aged monoculture;snags-elimination;old-growth forest - elimination;management implications

ABSTRACT: Measures of bird species diversity are commonly used as indicators of community structure relationships. Diversity of vegetation and structure within a habitat allows diversity in its avian community. Managed succession in the Douglas-fir region attempts to speed regeneration and establish an even-aged monoculture of Douglas-fir for harvest at optimal size. Bird species inhabitating 5 seral stage of these forests are identified. Four spheres of influence where timber management conflicts with forest birds are discussed: 1. Shortening of the grass-forb and shrub stage. 2. Effect of an even-aged Douglas-fir monoculture. 3. Elimination of snags. 4. Elimination of old-growth forest.

438

Meslow, E.C.; Maser, C.;Verner, J.
Old-growth forests as wildlife habitat.
Trans. North Am. Widl. and Nat. Resourc. Conf. 46: 329-335. 1981

KEYWORDS: old-growth forest;wildlife habitat;bird-habitat relationships;forest management;management implications;coniferous forest;Oregon USA;Washington USA

ABSTRACT: In this paper we propose to (1) acquaint the reader with the pertinent characteristics of old-growth forests of the Pacific Northwest, (2) identify a wildlife community associated with old-growth forests, (3) explore current management problems and strategies for old-growth forests, and (4) suggest action to acquire information that will strengthen the basis for management of old-growth forests on public lands.

439

Meslow, E.C.; Wight, H.M.
Avifauna and succession in Douglas-fir forests of the Pacific Northwest.
Pp. 266-271 in: D.R. Smith, tech. coord. Proc. of the symposium on management of forest and range habitats for nongame birds. USDA For. Serv. Gen. Tech. Rept. WO-1. 1975

KEYWORDS: avian ecology;avian succession;forest succession;bird-habitat relationships;avian diversity;timber management;silviculture;even-aged management;rotation period;snag removal;old-growth forest;management implications

ABSTRACT: In the Douglas-fir region of western Oregon and Washington, natural succession generally proceeds rapidly through grass-forb and shrub stages to enter a long period of Douglas-fir dominance. Climax forests of western hemlock and western red cedar are relatively ra[illegible] but old-growth forests of Douglas-fir, undisturbed to 400-600 years were relatively common. Timber management attempts to speed regeneration and establish an even-aged monoculture of Douglas-fir for harvest at optimal size. We identify the bird species inhabitating five seral stages of these forests and discuss four spheres of influence in which timber management conflicts with forest birds: 1) Shortening of the grass-forb and shrub stage. 2) Effect of an even-aged Douglas-fir monoculture. 3) Elimination of snags. 4) Elimination of old-growth forest.

440

Meyers, J.M.; Johnson, A.S.
Bird communities associated with succession and management of Loblolly-shortleaf pine forests.
Pp. 50-65 in: R.M. DeGraaf, tech. coord. Proc. of the Workshop: management of southern forests for nongame birds. Jan 24-26, 1978, Atlanta, Georgia. 1978

KEYWORDS: avian ecology;avian diversity;avian succession;forest succession;timber management;silviculture;clearcutting;selection harvesting;fire: prescribed;thinning;post-management responses;management implications;pine forest;USA

ABSTRACT: Published data from 17 winter and 32 summer bird censuses were used to determine changes in bird species composition, richness, and density in relation to plant succession and forest management in loblolly-shortleaf pine forests. Recommendations for habitat management are offered.

441

Micheal, E.D.; Thornburgh, P.I.
Immediate effects of hardwood removal and prescribed burning on bird populations.
Southwest Nat. 15:359-370 1971

KEYWORDS: logging;fire: prescribed;post-logging response;post-fire response;avian diversity;avian density;breeding status;habitat selection;management implications;Texas USA

ABSTRACT: Censusing of bird populations in three forest habitats was conducted from March 1966 through February 1968 in Nacogdoches County, Texas. The three habitats consisted of: 1) a pine stand in which all hardwoods had been killed or removed, 2) a pine-hardwood stand which included 25% hardwoods, and 3) a control unit that included 36% hardwoods, which had not been cut for several years. Hardwood removal and the following prescribed burn opened up the canopy, which resulted in dense growth of the understory. Major finds and conclusions of this study are: 1) The total number of birds in the three areas did not differ statistically during the first year prior to the prescribed burn. 2) Prior to burning, the area of complete hardwood removal supported the most kinds of birds. 3) Prior to burning, the red-eyed vireo was the only species showing a significant difference in nesting density. 4) Following burning, the number of birds in the partial hardwood removal area increased whereas the number in the control area decreased. 5) The species showing significant increases after burning were Carolina chickadee, yellow-shafted flicker, slate-colored junco, and robin. 6) Species diversity varied from 2.74 to 2.89, with differences not statistically significant. 7) Number of species varied from 19 to 24, and number of adult breeding birds per 100 acres varied from 1042 to 1350.

442

Miller, E.; Miller, D.R.
Snag use by birds.
Pp. 337-356 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: avian ecology;cavity-nesting birds;snags;snag uses;decay;forest management;forest residues;management implications

ABSTRACT: Primary cavity nesters select decayed places in trees for excavation. Decay incidence varies between areas and even between stands and is related to many factors both natural and man-caused. Some characteristics of nest sites used by a cavity nesting species vary with locality. These differences frequently reflect variations in decay incidence. Management plans for cavity nesters can be constructed using available information on stand and area history and decay. Creation of cavity nest trees cannot be facilitated by girdling. Size of nest trees, characteristics of decay and availability of suitable trees all affect cavity nesters. Dead and partly dead trees are important in many other ways. They are used for foraging, drumming, singing posts, food caching, nesting on, nesting under bark, hunting perches, loafing, lookouts, anvils, plucking posts, landing and roosting. Dead, dying, deformed and down trees play a vital role in a complex system.

443

Miller, E.; Partridge, A.D.;Bull, E.C.
The relationship of primary cavity nesters and decay.
Trans. Northeast Sec. Wildl. Soc. 36:60-68 1979

KEYWORDS:

ABSTRACT: not reviewed

444

Miyamoto, J.;
The implications of recent long-term toxicology studies of fenitrothion on birds
Pp. 307-319. In: Proceedings symposium on fenitrothion: The long-term effects of it in forest ecosystems. National Research Council of Canada. NRCC No. 16073 1977

KEYWORDS: chemical control;fenitrothion;long-term toxicology;avian growth;avian reproduction

ABSTRACT: Groups of young male and female Japanese quails were kept for 4 weeks on a diet containing 0, 1.5, 5, 15, and 50 mg fenitrothion per kg-feed. No abnormalities were found in behaviour, mortality, body weight gain, and food consumption; egg production was slightly suppressed only at the 50 mg/kg-feed level. The cholinesterase activity in whole blood and brain was significantly inhibited at the 15 and 50 mg/kg-feed levels. Enzymes in females were more susceptible to fenitrothion. Reproduction studies in bobwhite quails and mallard ducks revealed that fenitrothion given subacutely at rates up to 10 mg/kg-feed (quails) or 100 mg/kg-feed (ducks) did not adversely affect the parental growth and reactions, egg production, egg weight and quality, hatchability of the eggs, and growth and viability of the young.

445

Moeur, M.;
Predicting cover, shrubs, and relationships between stands for evaluation multi-resource silviculture.
Pp. 144-152 In: Proceedings of the National Silviculture Workshop: Silviculture for All Resources, Sacramento, California, May 11-14, 1978, USDA For. Serv. Timber Management, Wash, D.C. 1989

KEYWORDS: models: decision-support;shrub canopy/cover;stand relationships;silviculture: multi-resource;management implications

ABSTRACT: Decision-support models such as the Stand Prognosis System are valuable tools for evaluation tradeoffs among multiple resources. Essential features of such models are the ability to forecast vegetation changes, simulate management effects on vegetation, and relate the objectives of vegetation management to objectives for managing other resources. Components of the Prognosis Model that relate to wildlife habitat are discussed. These are projection of stand canopy structure and understory development, and simultaneous projection of groups of stands in a logical planning unit, with spatial and temporal interactions between them. Examples and potential applications of relating Prognosis Model projections to wildlife habitat are presented.

446

Monkkonen, M.; Helle, P.
Avian reproductive output in European forest successions.
Oikos 50: 239-246. 1987

KEYWORDS: forest succession;bird-habitat relationships;avian reproductive output;clutch size;brood number;migratory status;Europe

ABSTRACT: Data on North American land bird communities have supported the prediction of traditional succession theory that annual reproductive output of organisms would decrease in the course of succession. To test the universality of this idea the average clutch size, brood number and egg production per season (both unweighted and weighted with species abundance) were calculated for 11 European forest successions (58 successional stages altogether). The average clutch size and egg production weighted with species abundance were observed to increase significantly in the course of succession; the other two were not significantly correlated with the successional age. Migratory habit (sedentary species, short-distance migrants and long-distance migrants were distinguished) explained 50% of the variation in egg production unweighted with species abundance and 60% in egg production weighted with species abundance. The pattern observed deviates from the theoretical expectations and data from North America. The most probable reason for the between continent difference is the habitat choice of tropical migrants, whose annual egg production is fairly low in both continents. In North America tropical migrants prefer mature forest (resulting in a low mean egg production there), but in Europe they inhabit early and intermediate successional stages (resulting in a low mean egg production there).

447

Monson, G.;
The effect of revegetation on the small bird population in Arizona.
J. Wildl. Manage. 5:395-397 1941

KEYWORDS: vegetation;cover;food;bird populations;New Mexico

ABSTRACT: *The data obtained indicate that increased cover and food in the Demonstration Area had the effect of more than doubling the small bird population. This statement is conservative as Plots A' and B' had better vegetative cover than did Plots A and B before the Demonstration Area was set up. It is realized that four plots do not constitute an entirely satisfactory sample, but the difference in the bird populations between the conservatively grazed and the overgrazed plots was so great, more than 100%, that the findings are considered significant. It cannot be stated definitely, but it is believed, that the population increase was largely due to the cover factor, and to a lesser extent, to the increased food, both plant and insect, that had become available. A census at the close of the summer growing season, in late August or early September, would no doubt reveal an even greater difference in the comparative numbers of birds inside and outside of the Demonstration Area. Food and cover conditions inside the Area would then be better than in July, while outside the Area, because of heavy grazing, they would not materially change.

448

Moore, N.W.; Hooper, M.D.
On the number of bird species in British Woods.
Biol. Conserv. 8: 239-250. 1975

KEYWORDS: avian communities;avian diversity;bird-habitat relationships;forest fragmentation;forest size;conservation implications;Great Britain

ABSTRACT: The species of bird present in 443 woods in Great Britain were recorded during the breeding seasons of 1967 to 1974. Woods varied in size and in the number of species present which was found to be related to the area of the wood. The form of this relationship suggests a general similarity between ecological and geographical islands. Comparison is made with birds of heathland and of ponds. The implications of the work for bird conservation both on farms and in the country as a whole are discussed briefly.

449

Morely, A.;
Recolonization by bird species on burnt woodland.
J. Anim. Ecol. 9:84-88 1940

KEYWORDS: avian ecology;avian diversity;fire: wild;post-fire responses;recolonization;burnt woodland;East Sussex

ABSTRACT: *The bird life on 200 acres of burnt woodland in East Sussex was noted in the first and fourth summer after burning. In the first breeding season in five habitats, two species, mistle-thrush and nightjar, were present. In the fourth, in five habitats, six species were present: Tree pipit, willow-wren, and robin over the whole area; chaffinch, whitethroat and wood-pigeon on the fringe only. On unburnt forest, in twelve main habitats, thirty-six species were noted.

450

Morgan, K.H.;
Breeding bird communities of a post-clearcutting secondary succession in a Nova Scotia hardwood forest.
M.Sc. Thesis, Dalhousie Univ., Halifax, Nova Scotia. 1984

KEYWORDS:

ABSTRACT: not reviewed

451

Morgan, K.; Freedman, B.
Breeding bird communities in a hardwood forest succession in Nova Scotia.
Can. Field-Nat. 100:506-519 1986

KEYWORDS: clearcutting;forest succession;breeding birds;bird-habitat relationships;avian density;avian diversity;multiple regression analysis;principal component analysis;hardwood forest;Nova Scotia

ABSTRACT: The response of breeding birds to hardwood forest disturbance and regrowth was examined using a chronosequence of 23 stands aged from 1 to 74 years. The avifauna of young, clearcut stands (<= 12 years old) was distinct in both species and density from mature stands (>= 20 years old). The most important species of young stands were Chestnut-sided Warbler, Common Yellowthroat, Northern Junco, and White-throated Sparrow, while older stands were dominated by Least Flycatcher, Hermit Thrush, Red-eyed Vireo, Northern Parula, Black-throated Green Warbler, American Redstart, and Ovenbird. As clearcut stands developed and began structurally to resemble a forest, especially with the establishment of a tall, relatively dense shrub canopy, species of birds more typically associated with closed stands began to invade. Bird species density, diversity, and richness levelled off in the transitional stage between recent clearcuts and young forests, and at this stage there was a mixture of open and closed canopy species. With further succession, species typical of young stands were eliminated from the avifauna. The overall effects of timber harvesting upon the avifauna of this hardwood forest were not severe, and were of limited duration.

452

Morgan, K.H.; Wetmore, S.P.;Smith, G.E.J.;Keller, R.A.
Relationships between logging methods, habitat structure and bird communities of dry interior douglas-fir, ponderosa pine forests of British Columbia.
Can. Wildl. Serv., Pacific and Yukon Region. Tech. Rep. Ser. No. 71. 48 pp. 1989

KEYWORDS: diameter limit cutting;section cutting;breeding birds;bird-habitat relationships;avian diversity;avian density;foraging guilds;multivariate analysis;coniferous forest;British Columbia

ABSTRACT: The response of breeding birds to diameter limit and selection cutting of dry interior Douglas-fir and Ponderosa Pine forests was studied between 1983 and 1986. Multivariate analyses showed that the avifauna and the vegetation of the study areas near Princeton, B.C. were distinct from the birds and forests studied near Merritt, B.C. The responses of nesting and foraging guilds to habitat alterations predominantly followed expected trends. Neither logging method appeared to drastically harm the bird community. Opening up of the forest canopy resulted in a decline in several mature forest species, but overall tended to promote a more diverse avifauna. In general, the densities of birds showed little variation from year to year. Correlations between weather variables and groups of birds suggested that some of this yearly variation may have been due to temperature and precipitation patterns.

453

Moriarty, J.J.; McComb, W.C.
The long-term effect of timber stand improvement on snag and cavity densities in the central Appalachians.
Pp. 40-44 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: snags;tree-cavities;silviculture;timber stand improvement;girdling;management implications;Kentucky USA

ABSTRACT: Snag and cavity densities were measured on two watersheds in a mixed mesophytic forest in eastern Kentucky. One watershed received timber stand improvement (TSI) by girdling 20-30 years prior to measurement and one did not receive TSI. There were more snags of the TSI watershed than of the non-TSI watershed. Total cavity density was similar between watersheds, but the TSI watershed had a higher density of animal cavities while the non-TSI watershed had a higher natural cavity density. Management recommendations include selected TSI of heart-rotted trees on 10 to 15-year intervals to provide snags.

454

Morrison, M.L.;
The structure of western warbler assemblages: analysis of foraging behaviour and habitat selection in Oregon.
Auk 98: 578-588. 1981

KEYWORDS: warbler assemblages;clear-cuts: early growth;Douglas-fir plantations;habitat selection;foraging behaviour;avian density;preadaptation;Oregon USA

ABSTRACT: This study examines the foraging behaviour and habitat selection of a MacGillivray's - Orange-crowned - Wilson's warbler assemblage that occurred on early-growth clearcuts in western Oregon during breeding. Sites were divided into two groups based on the presence or absence of deciduous trees. Density estimates for each species were nearly identical between site classes except for Wilson's, whose density declined on nondeciduous tree sites. Analysis of vegetation parameters within the territories of the species identified deciduous tree cover as the variable of primary importance in the separation of warblers on each site, so that the assemblage could be arranged on a continuum of increasing deciduous tree cover. MacGillivray's and Wilson's extensively used shrub cover and deciduous tree cover, respectively; Orange-crowns concentrated foraging activities in shrub cover and maintained nondisturbance densities. Indices of foraging-height diversity showed a marked decrease after the removal of deciduous trees. All species except MacGillivray's foraged lower in the vegetative substrate on the nondeciduous tree sites. Indices of foraging overlap revealed a general pattern of decreased segregation by habitat after removal of deciduous trees. I suggest that the basic patterns of foraging behaviour and habitat selection evidenced today in western North America were initially developed by ancestral warblers before their invasion of the west. Species successfully colonizing western habitats were probably preadapted to the conditions they encountered, with new habitats occupied without obvious evolutionary modifications.

455

Morrison, M.L.;
Response of avian communities to herbicide-induced vegetation changes, Western Oregon.
Ph.D. Thesis, Oregon State Univ., Corvallis. 77 pp. 1982

KEYWORDS: clearcuts;herbicide modification;avian communities;post-treatment responses;avian diversity;avian density;foraging behaviour;discriminant function analysis;management recommendations;Oregon USA

ABSTRACT: The relationships between avian community structure and herbicide modification of vegetation were analyzed on early-growth clearcuts in western Oregon that had received phenoxy herbicide treatment 1 or 4 years previously. Only minor effects of herbicide treatment were evident 1 year after spraying, except for red alder, which still exhibited moderate to severe damage. Most plants showed no obvious signs of the treatment by 4 years postspray. For both 1 and 4 years post-spray, vegetation development was greater in the second (1.0-3.0 m) and third (>3.0 m) height intervals on untreated (Control) sites; vegetation cover in the lowest (<1.0 m) interval did not vary between treated and untreated sites. All measures of vegetative diversity on untreated sites exceeded those on sprayed sites. Discriminant function analysis identified deciduous tree cover as of primary importance in separation of vegetation of treated and untreated sites. Overall density and diversity of birds were similar between treated and untreated sites. Several bird species altered patterns of foraging behavior on treated sites. Differences in habitat use were identified for several species; birds using deciduous trees were found to increase use of shrubs on treated sites. Deciduous tree cover usually functioned in ordination of the avifauna on both treated and untreated sites. The primary effect of herbicide application was a reduction in the complexity of vegetation on treated sites, a condition due primarily to the removal of deciduous trees. The substantial shrub cover on treated sites, however, apparently allowed maintenance of an overall avian density similar to that of untreated sites. Small patches of deciduous trees, scattered about on clearcuts treated with phenoxy herbicides can maintain an avian community that is similar to that on untreated sites.

456

Morrison, M.L.; Meslow, E.C.
Avifauna associated with the early growth vegetation on clearcuts in the Oregon Coast ranges.
USDA For. Serv., Pacific Northwest Forest and Range Exp. Stn., Research Paper PNW-305. 1983

KEYWORDS: avian diversity;avian density;clearcutting;bird-habitat relationships;site preparation;forest succession;breeding birds;management implications;Oregon USA

ABSTRACT: This paper provides estimates of bird density, diversity, and evenness on 13 clearcut units of the Siuslaw National Forest in the Coast Ranges of Oregon, sampled during 1979, 1980, and 1981. Total density of nesting birds ranged from 322 to 588 per 40.5 hectares (100 acres); there were 15-19 species nesting on each site.

457

Morrison, M.L.; Meslow, E.C.
Bird community structure on early-growth clearcuts in western Oregon.
American Midland Naturalist 110:129-137 1983

KEYWORDS: clearcuts;early-growth;avian diversity;avian density;bird-habitat relationships;habitat heterogeneity;post-logging responses;discriminant function analysis

ABSTRACT: Total density of nesting birds ranged from 326-552 birds/40.5 ha on 12 early growth clearcuts in western Oregon. The number of nesting species varied little among sites. Predominant species (ca. 50 birds/40.5 ha/site) on all sites were the white-crowned sparrow, song sparrow, rufous hummingbird, and Swainson's thrush. Nesting species with moderate density estimates (ca. 30 birds/40.5 ha) were the willow flycatcher, American goldfinch, rufous-sided towhee, and orange-crowned warbler. MacGillivray's warbler and Wilson's warbler were present on all sites, although their densities were low (ca. 20 birds/40.5 ha). Discriminant function analysis of habitat use by birds identified three functions with significant ability to separate bird communities. Increasing cover and height of deciduous trees (Factor I) accounted for the majority of variation (74.5%). Placement of species on the first three discriminant axes was related primarily to varying combinations of shrubs and deciduous trees. Total density of nesting birds decreased with increasing height of conifers, but increased with increasing cover of deciduous trees. Densities of the bird communities increased where patches of deciduous trees formed breaks in plant communities dominated by shrubs and conifers.

458

Morrison, M.L.; Melow, E.C.
Impacts of forest herbicides on wildlife; Toxicity and habitat alteration.
Trans. N. Am. Wildl. and Nat. Resour. Conf. 48:175-185 1983

KEYWORDS: forest herbicides;wildlife: effects on;bird populations;toxicity;habitat alteration;bird-habitat relationships;management implications

ABSTRACT: While residues of herbicides can be detected in the environment, these residues are of low concentrations and short-lived. Further, while residues are sometimes detected in wildlife, levels in tissues are low and do not accumulate. Thus while the link between herbicides and their toxic effects on wildlife has been established, this link is simply not capable of passing significant effects on to wildlife if recommended application procedures are followed-the only exception being localized cases of possible phytotoxicity that influence diet preference. The general response of wildlife to herbicide application can thus be predicted if data are available on the range of habitats occupied by a species and their density in these habitats.

459

Morrison, M.L.; Meslow, E.C.
Response of avian communities to herbicide-induced vegetation changes.
J. Wildl. Manage. 48:14-22 1984

KEYWORDS: silviculture;herbicides: effects of;clearcutting;forest succession;bird-habitat relationships;avian density;avian diversity;foraging ecology;management implications;coniferous forest;Oregon USA

ABSTRACT: The relationships between avian communities and herbicide modification of vegetation were analyzed on early-growth clear-cuts in western Oregon that had received phenoxy herbicide treatment 1 or 4 years previously. For both 1 and 4 years post-spray, vegetation development was greater in the third height interval (>3.0 m) on untreated sites. All measures of vegetative diversity on untreated sites exceeded those on treated sites. Overall density and diversity of birds were similar between treated and untreated sites. Several bird species altered their foraging behavior on treated sites; i.e., birds using deciduous trees increased use of shrubs on treated sites. The primary effect of herbicide application was a reduction in the complexity of vegetation, a condition due primarily to the removal of deciduous trees. Small patches of deciduous trees scattered in clear-cuts treated with phenoxy herbicides can maintain an avian community similar to that on untreated sites.

460

Morrison, M.L.; Meslow, E.C.
Effects of the herbicide glyphosate on bird community structure, Western Oregon.
For. Sci. 30:95-106 1984

KEYWORDS: herbicide: effects of;avian community structure;avian density;avian diversity;bird-habitat relationships;clearcutting;coniferous forest;Oregon USA

ABSTRACT: A study was conducted on vegetative changes induced by the herbicide glyphosate, and the resultant habitat use of birds nesting on two clearcuts in western Oregon. About 23 percent of total plant cover was initially damaged by aerial application of glyphosate. Most measures of vegetation on the treated site decreased relative to the untreated site 1 year after glyphosate application. By 2 years post-spray, vegetation on the treated site had recovered to near pre-spray status. No difference in density of the bird community was evident between treated and untreated sites during all years of study although individual species densities were modified. Several bird species decreased their use of shrub cover, and increased their use of deciduous trees 1 year after treatment. By 2 years post-spray, many species had returned to pre-spray use of most measured habitat components. Results indicated that application of glyphosate can modify the density and habitat use of birds.

461

Morrison, M.L.; Raphael, M.G.;Heald, R.C.
The use of high cut stumps by cavity nesting birds.
Pp. 73-79 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: avian ecology;cavity-nesting birds;cavity-nest characteristics;snags;stumps;economics;management implications;California USA

ABSTRACT: This paper discusses the use of high-cut stumps by cavity nesting birds. Although high-cut stumps are less hazardous and present little revenue loss compared to taller snags, virtually no information is available on the use of such stumps by birds. Literature sources and research results indicate that few species will readily use such stumps. Creating high-cut stumps is economically feasible, however. It is recommended that high-cut stumps be used as replacements for tall snags only in areas of potential safety hazard.

462

Morrison, M.L.; Timossi, I.C.;With, K.A.
Development and testing of linear regression models predicting bird-habitat relationships.
J. Wildl. Manage. 51:247-253 1987

KEYWORDS: avian density;forest structure;technique: model;bird-habitat relationship;linear regression models;California USA

ABSTRACT: We used an existing forest inventory data base to develop models predicting the abundance of birds collected during the summers of 1983-85 in a mixed-conifer forest of the western Sierra Nevada. Stepwise multiple linear regression was used to develop models for 21 species of birds. Adjusted coefficients of multiple determination (R squared) were low, ranging from 0.02 to 0.24. We used 1984 count data to validate models developed during 1983 ('same place, different time' validation). Most predictions ranged from 25-50% underestimates of observed values. We combined 1983 and 1984 data to produce models used to predict count data collected during 1985 from different locations ('different place, different time' validation). Predictions were about 50-75% underestimates of observed values. Most observed values were, however, within the confidence intervals generated from the predictive equations. Although our final regression models were successful in predicting presence-absence of most species, it is doubtful that forest inventory systems can be used to predict bird abundance.

463

Morrison, M.L.; With, K.A.;Timossi, I.C.
The structure of a forest bird community during winter and summer.
Wilson Bull. 98: 214-230. 1986

KEYWORDS: forest bird communities;avian abundance;avian structure;bird-habitat relationships;migratory status;mixed-coniferous forest;management implications;California USA

ABSTRACT: We examined the abundance and use of habitat by birds during winter and summer in a mixed-conifer forest of the western Sierra Nevada. Of the species present during both seasons, 4 had significantly higher indices of abundance in winter, whereas none had higher summer indices. Bird species differed significantly in habitat use during summer as identified by discriminant function analysis (DFA). The spacing of large trees separated birds along the first DFA axis; the second axis was defined by the size of foraging trees. There was also a significant difference in habitat use among species during winter. The size of foraging trees and the diameter of the small (11-30 cm dbh) trees defined the first function; the second function was defined by high canopy cover. In both seasons, however, an unbiased classification procedure separated all species poorly. There was a significant difference in the overall pattern of habitat use by permanent resident birds between winter and summer. All species showed significant differences in habitat use vs habitat availability during both winter and summer. Overwintering birds used areas characterized by high, heavy canopy cover and heavy subcanopy cover relative to summer use. Our results suggest that forest managers should give increased attention to the structure and species composition of managed forests.

464

Morse, D.H.;
The occupation of small islands by passerine birds.
Condor 79:399-412 1977

KEYWORDS: forest islands;forest area;forest structure;bird-habitat relationships;avian diversity;avian density/biomass;avian turnover;biogeography

ABSTRACT: *Breeding landbirds on 12 small (0.1-4.0 ha), forested islands in Muscongus Bay, Maine, were censused from 1967 through 1975. All 17 species that bred also occupied spruce forests or adjacent disturbed habitats on the nearby mainland. Similar numbers of species came from both areas, but since most islands were spruce-covered, the contribution from the disturbed areas exceeded that predicted by chance. Size of forest accounted for the greatest amount of variation in numbers of species present, while the total area vegetated, amount of ground cover, and forest height made lesser contributions. Total vegetated area accounted for the greatest amount of variation in numbers of species present from the disturbed areas, however, even though this study only treated the species that occupied the forested parts of the islands. When the smallest islands (<0.2 ha) were removed from the calculation, z (slope of the log-log regression of species against area) fell near 0.20, which approaches a typical mainland figure. Including the smallest islands in the calculation, z was about 0.50, probably because these islands were too small to support most species. Some species occurred only on islands at least as large as their territory sizes on the mainland, while others decreased their territory size considerably. Those bird species not predicted on the basis of the size of their mainland territories often were low in the social hierarchy and demonstrated ecological release on the islands. Following two poor breeding seasons, spruce-forest species declined markedly, while those of disturbed areas increased; consequently, the islands remained in equilibrium when taken as a group. Turnover rates of species averaged 16.7%/yr. Numbers of vagrants actually observed were adequate to saturate the islands, at least in some years. Overall density, biomass, and metabolic demand generally changed inversely with forest size and exceeded those on the adjacent mainland.

465

Morton, E.S.;
Our migrant birds: Can we continue to take them for granted?
Atlantic Nat. 33:36-40 1980

KEYWORDS:

ABSTRACT: not reviewed

466

Moss, D.;
Diversity and woodland song-bird populations.
J. Anim. Ecol. 47: 521-527. 1978

KEYWORDS: avian diversity;forest structure;bird-habitat relationships;plantations;semi-natural woodland;Scotland

ABSTRACT: Song-bird populations were censused by the mapping method and vegetation profiles were measured on 18 plots in planted and semi-natural woodland in Scotland over 1-3 years. The diversities of the song-bird communities were calculated using a standard formula; the complexity of vegetation structure on each plot was measured by the diversity of the distribution of foliage within a number of height ranges. With an optimum choice of height ranges into which the vegetation profiles were divided, the correlation coefficient between bird species diversity (BSD) and foliage height diversity (FHD) was 0.887. There were 4 height ranges: 0-0.6 m, 0.6-6 m,6-15 m, > 15 m. Use of numbers of song-bird species or total densities in place of bird species diversity resulted in lower correlation coefficients. The increase in bird species diversity with increase in foliage height diversity was seen as the result of the exploitation of an increased number of available niches. The regression line between BSD and FHD could be used to predict BSD when FHD was known.

467

Moss, D.;
Song-bird populations in forestry plantations.
Q. J. For. 72: 5-14. 1978

KEYWORDS: breeding birds;avian density;avian diversity;habitat suitability;mixed-wood;coniferous forest;Scotland

ABSTRACT: Breeding song-bird populations were censured in spruce, pine and larch plantations in southern Scotland, and in pine plantations in the Highlands. They were compared with populations in semi-natural woodlands in the two areas. Total densities were highest in the semi-natural woods, lower in the spruce and least in the pine plantations. Numbers of species were also lower in the plantations. The distributions of the commoner species are described in relation to their habitats, and the subject of woodland song-bird density is discussed more generally.

468

Moss, D.; Taylor, P.N.;Easterbee, N.
The effects on song-bird populations of upland afforestation with spruce.
Forestry 52: 129-150. 1979

KEYWORDS: afforestation;coniferous plantations;silviculture;breeding songbirds;avian diversity;avian density;bird-habitat relationships;Scotland

ABSTRACT: 1. Large coniferous plantations have been established widely in uplands previously used for rearing sheep and cattle, causing fundamental changes in the wild life of these areas. 2. Breeding song-birds were censused in south-west Scotland on upland moorland grazed by sheep and in spruce plantations at different stages of growth. 3. The commonest song-bird species were meadow pipit and skylark on unplanted areas, meadow pipit in established plantation, willow warbler and wren in thicket, and goldcrest, chaffinch and wren in polestage and thinned plantations. 4. Many bird species depend on unafforested moorland, but were not censured since they are too sparsely distributed. Their loss is to be set against the gain in numbers of smaller song-birds following afforestation which was inferred from the study plots. From the standpoint of bird conservation, diverse forest structure and the retention of some large unafforested upland areas is advocated.

469

Moulding, J.D.;
Effects of a low-persistence insecticide on forest bird populations.
Auk 93:692-707 1976

KEYWORDS: forest bird populations;insecticides: effects of;Sevin (carbamate);avian density;avian diversity

ABSTRACT: *The impact of the insecticide Sevin on a forest bird community was studied within a functional gypsy moth control program in New Jersey in 1971. The only modification for the purpose of the study was the respraying of the study plots to obtain a more even application. Extensive pre- and postspray bird censuses were conducted in replicate sprayed and control study plots using a strip transect method. These revealed a consistent, gradual decline in bird numbers, species richness, and diversity during the 8 weeks following spraying. By the end of July, bird abundance was 55% below control levels. Bird populations continued to be depressed in the sprayed plots the following summer, although no further spraying was conducted. The average population level then was 45% lower than in the corresponding period before spraying the previous year. Some evidence suggests the effect was greater in canopy-foraging birds than in ground-foragers. The mechanisms of these effects are not known. It is hypothesized that they are the result of some combination of opportunistic feeding outside the sprayed area, possible reduced reproductive success and shift in site loyalty in some portion of the avian community. Recent data from other studies indicate that decreases in bird abundance following spraying may be caused by several other short-lived insecticides when used for forest insect control. It is suggested that to clarify the mechanisms of these effects, more data are needed on the behavior of individual adult birds, and on nestling and fledgling survival, particularly in nests that hatch or fledge young within 1 or 2 days of the spray.

470

Munger, G.P.;
Breeding bird diversity in Douglas-fir stands of western Montana as related to forest structure.
M.S. Thesis, Univ. Montana, Missoula. 51 p. 1974

KEYWORDS:

ABSTRACT: not reviewed

471

Myers, C.A.; Morris, M.J.
Watershed management practices and habitat values in coniferous forests.
Pp. 288-294 in: D.R. Smith, tech. coord. Proc. of the symposium on management of forest and range habitats for nongame birds. USDA For. Serv. Gen. Tech. Rept. WO-1. 1975

KEYWORDS: watershed management;clear cutting;plantations;thinning;fire: burns;strip cutting;patch cutting;land use management;bird-habitat relationships;management implications

ABSTRACT: Applications of watershed management practices in coniferous forests can produce thinned stands, cleared openings, and new plantations. Clear cutting patches to increase water yields has the greatest potential for changing nongame bird habitats. Changes in the vegetative cover will increase habitat diversity, which is frequently, but not always, beneficial to birds.

472

Myiberget, S. ed., ;
Forest birds and forestry.
Norsk Skogbruk 31:17-32 1985

KEYWORDS:

ABSTRACT: not reviewed

473

Nagy, J.G.; Schwartz, C.C.
Effects of forest management practices on wildlife in the central and southern Rocky Mountain region, U.S.A.
Pp. 690-699 In: Proceedings of the XVI IUFRO Congress.

KEYWORDS: clearcutting;fire:effects of;selection cut;single tree selection;wildlife habitat suitability;coniferous forest

ABSTRACT: Effects of timber harvest practices on wildlife in three different needle-leaved forest zones of the central and southern Rocky Mountain Region are presented and discussed. Clearcut openings in both the Engelmann spruce subalpine fir and the lodgepole pine zones appears to benefit both mule deer and elk by increasing available foliage. Partial cutting is of benefit to blue grouse. Clearcutting of ponderosa pine forests also benefits deer and elk, but is generally detrimental to both the Abert's and kaibib squirrel. Controlled fire is currently being tested as a practical management tool for improvement of both wildlife habitat and forested areas. Effects of logging on outdoor recreation and tourism are also being discussed.

474

Nelson, S.G.;
The interrelationships of habitat complexity, secondary succession, season and bird populations in southern California chaparral.
M.A. thesis. Univ. Calif., Riverside. 68 p. 1975

KEYWORDS:

ABSTRACT: not reviewed

475

Nero, R.W.; Clark, R.J.;Knaptor, R.J.;Hamre, R.H., eds.
Biology and conservation of northern forest owls, symposium proceedings
USDA For. Serv. Gen. Tech. Rept. RM-142 309 pp. 1987

KEYWORDS: northern forest owls;symposium;ecology;biology;management implications

ABSTRACT: Proceedings of this first international symposium consist of 47 presented papers covering 15 owl species, and 4 workshops dealing with capture, telemetry, census, and management techniques. Basic information on habitat preferences, home range size, detecting lesser known owls, etc. will be invaluable to managers of wildlife and of forested lands; techniques information will be invaluable to researchers.

476

Newton, I.;
Birds and forestry.
Pp 21-30 In: E.H.M. Harris, ed. Forestry and Conservation. Royal Forestry Society, London. 1983

KEYWORDS: avian diversity;avian density;afforestation: effects of;forest structure;monoculture;even-aged forest;uneven-aged forest;Britain

ABSTRACT: *Tree planting on open ground leads to an increase in the numbers and diversity of birds, particularly songbirds. Widespread softwood culture has led to major expansions in the geographical range of crossbill and siskin in Britain. Monocultures of well-grown conifers typically contain up to fifteen song-bird species, at total densities of 300-500 pairs per sq. km. Both figures are fewer than in broad-leaved stands, and fewer still than in mixed conifer/broad-leaved stands. Even-age stands also contain fewer bird species than do mixed-stage stands. For any given tree species, large woods contain more bird species, but at lower density, than do small woods, and woods on good soil contain higher bird densities than do woods on poor soil. The addition of some forest to an otherwise open hill region improves the variety of birdlife, without adversely affecting the open country predatory birds, which bird-watchers consider of high conservation value. However, widespread blanket afforestation, as in Galloway and Northumbria, in which little of the original sheepwalk and heather moor remains, leads to marked declines in predatory birds, including golden eagles, buzzards, merlins and ravens. On a national scale, no bird species has yet seriously declined due to afforestation.

477

Niemi, J.;
Habitat alterations: its effect on avian composition.
M.Sc. Thesis. Univ. of Minn., Duluth. 100 p. 1976

KEYWORDS:

ABSTRACT: not reviewed

478

Niemi, G.J.; Hanowski, J.M.
Relationships of breeding birds to habitat characteristics in logged areas.
J. Wildl. Mange. 48: 438-443. 1984

KEYWORDS: logging;breeding birds;post-logging responses;avian density;avian diversity;bird-habitat relationships;management implications;Minnesota USA

ABSTRACT: Habitat and breeding bird populations were examined in logged areas of northern Minnesota. A gradient of habitat complexity was related with increasing density and basal area of dead trees, live trees, and shrubs. The combined densities of 26 breeding species ranged from 3.9 in the least complex habitat to 8.6 territorial males/ha in the most complex. The chestnut-sided warbler, mourning warbler, white-throated sparrow, and song sparrow represented an average of 75% of the individuals on the eight plots. Only the density of the chestnut-sided warbler was positively correlated ($P < 0.05$) with the habitat gradient, while the song sparrow was negatively correlated ($P < 0.05$). Management for greater habitat complexity provides more opportunites for nesting and foraging and results in greater species richness and density of birds breeding in early successional vegetation.

479

Niemi, G.J.; Pfannmuller, L.
Avian communities: Approaches to describing their habitat associations.
Pp. 154-178 in: R.M. DeGraaf and K.E. Evans, tech. coord. Management of north central and northeastern forests for nongame birds. Workshop Proc., Jan 23-25, 1979, Minneapolis, Minnesota. USDA For. Serv. Gen. Tech. Rept. NC-51. 1979

KEYWORDS: avian ecology;bird-habitat relationships;successional stages;life forms;sociological association;avian diversity;avian density;modelling;management implications

ABSTRACT: Four approaches are presented which enable wildlife managers to consider many avian species simultaneously in management objectives. The northeastern Minnesota avifauna is used to test each approach. Three approaches included the classification of avian species into structural successional stages, life forms, or their sociological associations. The fourth approach, habitat niche, depicts species response to quantitative habitat variables. The background, methods, data analysis, interpretation, and advantages/disadvantages of each approach are discussed.

480

Nilsson, S.G.;
Estimates of population density and changes for titmice, nuthatch, and treecreeper in southern Sweden - an evaluation of the territory mapping method.
Ornis Scand. 8: 9-16. 1977

KEYWORDS: techniques: census;territory mapping method;avian density;breeding birds;resident birds;mixed-wood forest;Sweden

ABSTRACT: The efficiency of the international standard for estimating population density and changes was tested in two woodland plots (46 and 70 ha). Population changes were poorly reflected when only 10 surveys per year conducted. This was due to yearly differences in total census efficiency. The efficiency was different for different species and was affected also by the time of the censuses in relation to the breeding cycle. Recommendations to overcome some difficulties are given.

481

Nilsson, S.G.;
Effect of forest management on the breeding bird community in southern Sweden.
Biol. Conserv. 16: 135-143. 1979

KEYWORDS: forest management;natural regeneration;avian density;bird-habitat relationships;cavity-nesting birds;mixed-wood forest;coniferous forest;Sweden

ABSTRACT: A natural and a managed forest of similar age were compared. Total bird density was three times higher in the natural forest. All species groups had higher population densities in the natural forest, but woodpeckers and warblers much more so than other groups. Hole-nesting species made up about the same proportion of the bird communities in the natural and the managed forests. Bird density in a young spruce plantation was one-ninth that in the natural forest. Species number was higher in the natural then in the managed forest.

482

Noble, R.E.; Hamilton, R.B.
Bird populations in even-aged loblolly pine forests of southeastern Louisiana.

Proc. Southeast. Assoc. Game and Fish Comm. 29:441-450 1976

KEYWORDS: avian ecology;avian diversity;breeding birds;avian succession;forest succession;even-aged forests;management implications;pine: loblolly;Louisiana USA

ABSTRACT: Wintering and breeding-bird populations were determined for even-aged loblolly pine stands 6 years, 20 years, and 46 years old in Livingston Parish, Louisiana. Comparative data were collected in a natural stand. These stands supported bird populations lower in density and species diversity than the natural forest. As vegetative strata increased in a stand, the number and kinds of birds present, also increased.

483

Noon, B.R.;
Techniques for sampling avian habitats.
Pp. 42-52 in: D.E. Capen; ed. The Use of Multivariate Statistics in Studies of Wildlife Habitat. USDA For. Serv. Gen. Tech. Rep. RM-87. 1981

KEYWORDS: techniques;avian habitat;habitat assessment;standardized procedures

ABSTRACT: Standardized methodologies for the sampling of bird-related vegetation structure in forest and non-forest habitats are proposed. For forest habitats, the methodology is based largely on techniques proposed by James and Shugart (1970). For non-forest habitats, the methodology is a syntheses of many previously published techniques, particularly those of Wiens (1969). For each habitat type a detailed sampling protocol and sample field data sheet are provided. In addition, statistical and biological considerations for the location of sampling points are discussed. The paper ends with an argument in favor of standardized methods of sampling avian habitats.

484

Noon, B.R.; Able, K.P.
A comparison of avian community structure in the northern and southern Appalachian Mountains.
Pp. 98-117 in: R.M. DeGraaf, tech. coord. Proc. of the Workshop: management of southern forests for nongame birds. Jan 24-26, 1978, Atlanta, Georgia. 1978

KEYWORDS: avian ecology;avian community structure;avian diversity;bird-habitat relationships;habitat selection;management implications;Vermont USA

ABSTRACT: The structure of avian communities along elevational gradients is examined. A descriptive analysis of community-level properties, contrasting northeastern and southeastern communities, is presented. Hypotheses sufficient to explain differences in community organization are proposed and examined by analysis at the population-level. Emphasis is placed on shifts in species habitat utilization subsequent to changes in species composition and habitat availability. Suggestions for the development of workable habitat management schemes are presented.

485

Noon, B.R.; Bingman, V.P.;Noon, J.P.
The effects of changes in habitat on northern hardwood forest bird communities.
Pp.33-48 in: R.M. DeGraaf and K.E. Evans, tech. coord. Management of north central and northeastern forests for nongame birds. Workshop Proc., Jan 23-25, 1979, Minneapolis, Minnesota. USDA For. Serv. Gen. Tech. Rept. NC-51. 1979

KEYWORDS: habitat disturbance;avian ecology;avian diversity;habitat selection;bird-habitat relationships;forest succession;avian communities;management implications

ABSTRACT: The effects of habitat change on the avian communities of northern hardwood forests were examined from several perspectives, First, we critically reviewed published reports dealing specifically with the response of birds to habitat change. We then examined bird census data from communities representing varying degrees of habitat disturbance. Specifically, we analyzed census data according to the shape of their rank-abundance distributions and drew inferences about their community structure according to their fit to known distributions. The consensus of the published accounts that we reviewed is that, over the long term, bird communities are very resilient to habitat change. We generally concur with these feelings but with notable exceptions. Most importantly we found that the rare species of undisturbed forests are particularly sensitive to habitat changes. In many disturbed habitats the rare species group is either greatly reduced or completely eliminated. From a conservation perspective, we feel that the normally rare species of undisturbed forests should be of primary concern to forest managers in order to assure their persistence.

486

Nowakowski, N.A.;
Assessment of snag policies and their effects on timber harvest.
M.S. Thesis. Univ. Arizona, Tacson. 85 p. 1980

KEYWORDS:

ABSTRACT: not reviewed

487

O'Meura, T.E.; Haufler, J.B.;Stelter, L.H.;Nagy, J.G.
Nongame wildlife responses to chaining of pinyon-juniper woodlands.
J. Wildl. Manage. 45:381-389 1981

KEYWORDS: chaining;forest succession;avian diversity;avian density;breeding birds;bird-habitat relationships;management implications;coniferous forest;Colorado USA

ABSTRACT: Nongame wildlife responses to chaining of pinyon-juniper woodland were studied in 1977 in the Piceance Basin, Colorado. Vegetation and small-mammal populations were sampled on a mature pinyon-juniper woodland (control) and areas chained 1,8,and 15 years previously. Breeding-bird populations were studied on the areas chained 8 and 15 years previously, the control area, and on the edge between a mature woodland and an area chained 10 years previously. Ten species of breeding birds were observed on the unchained area, whereas only 3 and 4 species were observed on the 8- and 15-year-old chained areas, respectively. Bird densities on the unchained area (29 territories/10ha) were more than double those on the chained areas (11/10 ha). Five of 17 species breeding on the edge area used both vegetation types. Only 1 species was found exclusively on the edge area. Small mammals were more abundant on chained than unchained areas. Species composition of the catch varied among the chained and unchained areas; species diversity was greatest on the unchained area. Adverse effects on nongame wildlife could be minimized by favouring survival of shrubs and young trees, retaining selected cavity trees, and limiting widths of clearings when chaining pinyon-juniper.

488

Odum, E.P.;
Bird populations of the Highlands (North Carolina) Plateau in relation to plant succession and avian invasion.
Ecology 31:587-605 1950

KEYWORDS: forest structure;forest succession;bird-habitat relationships;avian diversity;avian density;avian invasion

ABSTRACT: *Breeding bird populations were measured on six plots representing shrubland, intermediate forest, and mature or climax forest states in the hemlock and oak-chestnut seres. Population density was high in the shrubland stages of both seres. In the oak-chestnut seres density was less in the forest stages, while in hemlock sere high populations were maintained or increased in the mature stages. The bird communities of the two seres were similar, though abundance of many species differed. Greater moisture and greater development of the forest shrub understory are believed to be the key factors which produce the higher populations found in the mature forests of the hemlock sere as compared with the comparable stages of the oak-chestnut sere.

489

Oelke, H.;
Pine forest of the southern Canadian Shield.
Aud. Field Notes 21:619-620 1967

KEYWORDS: pine plantation;avian diversity;avian abundance;Canadian shield

ABSTRACT: *Avian species and abundances as well as vegetative components, are given for a young, open pine plantation of the southern Canadian Shield. The high bird density in the plantation is attributed artificial nest boxes put in place by conservation programs.

490

Oliveri, S.F.;
The implications of intensive forest management practices for wildlife in Maine.
Pp. 259-267 in: J.A. Bissonette, ed. Is good forestry good wildlife management? Proc. of a Joint Conference, March 6-8, 1985, Portland, Maine. 1986

KEYWORDS: land use impacts;forest management;silviculture;herbicides;rotation period;clearcutting;stand conversion;plantation;fire control;insecticides;management implications

ABSTRACT: The effects of 10 intensive forest management practices upon wildlife are reviewed. Herbicides, shorter rotations, road development, clearcutting, whole-tree and biomass harvesting, hardwood utilization and stand conversion, thinning, planting, fire control, and insecticides are prominent practices that have both positive and negative effects upon different wildlife species.

491

Opdam, P.; Schotman, A.
The influence of forest structure and management on bird populations.
Nederlands Bosbouwtijdschrift 58:21-33 1986

KEYWORDS: breeding-bird richness;bird-habitat relationships;habitat heterogeneity;tree diameter;dead wood;management implications;Netherlands

ABSTRACT: *Forest bird species show different distributions in vertical and horizontal space. Hence, vegetation structure, particularly number of vegetation layers and patchiness (heterogeneity), can be expected to be of great significance for the bird fauna. The main approaches to associate bird communities to habitat features are summarized. The role of the number of vegetation layers or foliage height diversity is stressed mainly in studies comparing various stages of forest succession or various habitat types including fields and brushwood. In a comparison between various mature forest types, however, the main differences in bird communities are related to spatial heterogeneity, particularly in forest with high coverage of the canopy. The role of tree species diversity is difficult to assess because of correlation with other structural variables, but there is evidence for its effect on bird richness in mature woods. The same can be said of the proportion of dead wood (snags) and the tree diameter which seems especially relevant to tree-stem foragers and hole-breeding species. The correlation of various structural properties in forests complicates the interpretation of results of these studies. However, in forest management aimed at development of natural processes it will be sufficient to consider the components of forest structure as a complex of covarying variables. To enhance the breeding bird richness in forests, management should aim at increasing the tree diameter and the heterogeneity of the canopy and shrub layers.

492

Osaki, S.K.;
An assessment of wildlife populations and habitat in herbicide-treated Jeffrey pine plantations.
M.S. Thesis, Univ. of California, Berkeley. 83 p. 1979

KEYWORDS:

ABSTRACT: not reviewed

493

Otvos, I.S.;
The effects of insectivorous bird activities in forest ecosystems: an evaluation.
Pp. 341-374 in: J.E. Dickson, R.N. Conner, R.R. Fleet, J.C. Kroll, and J.A. Jackson, eds. The role of insectivorous birds in forest ecosystems. Academic Press, New York. 381 pp. 1979

KEYWORDS: forest ecosystem;insectivorous birds;bird-insect relationships;insect predation;seed dispersal;nutrient recycling

ABSTRACT: Insectivorous birds play an important role in the forest ecosystem. They have a significant influence on the population dynamics of many forest insects. Birds act as direct mortality agents of insect pests, and they can also affect their prey indirectly through influencing insect parasites and predators of the prey, by spreading entomogenous pathogens, or in some cases by altering the microhabitat of the prey. Birds exert the greatest influence on insect populations at endemic levels; they suppress and delay population build-up to epidemic levels, and thus may increase the interval between insect outbreaks. Insectivorous birds may also accelerate the decline of an outbreak. They may also have an effect on the forest ecosystem by feeding on and by dispersing seeds of various forest trees and shrubs. Some birds may be involved in the spreading of wood rotting fungi and thus contribute to the nutrient recycling.

494

Patil, G.P.; Taillie, C.
A study of diversity profiles and orderings for a bird community in the vicinity of Colstrip, Montana.
Pp. 23-48 in: Patil, G.P., and M. Rosenzweig eds., Contemporary quantitative ecology and related ecometric. International Co-operative Publishing House, Fairland, MD. 1979

KEYWORDS:

ABSTRACT: not reviewed

495

Patrice, R.;
Biogeographic factors affecting the wintering distributions of nearctic avian migrants in the Neotropics.
Ph.D. Thesis, University of Wisconsin, Madison, WI. 243 pp. 1987

KEYWORDS: nearctic avian migrants;wintering distributions;biogeographic factors;winter habitat

ABSTRACT: This study addresses several questions regarding broad-scale distribution patterns of migrant birds wintering in the Neotropics: "Where do northern avian migrants winter? What are the spatial patterns of northern avian migrants on their wintering grounds? What biogeographic variables help to explain these spatial patterns?" The study has a visual emphasis and uses stepwise multiple regression models to evaluate importance of biogeographic factors on wintering distribution patterns. I divided Latin America into 98 five degree latitude-longitude blocks (250,000 sq m) and determined the number of avian migrant species and measures of 24 biogeographic variables for each block. Stepwise multiple regression was used to order the biogeographic variables by the extent to which they reduced residual variance in the number of migrant species in the 98 blocks. Total number of migrant species and the number of migrant species within eight feeding guilds were used as dependent variables. Results showed that species of Nearctic avian migrants in the Neotropics winter most commonly in Central America with numbers of species decreasing east of Venezuela and south of northern Peru. Of the 24 biogeographic variables, migration distance had the greatest influence on where the most number of migrant species winter: The spatial distribution maps of total number of migrant species and migration distance showed inverse patterns, and distance had a significant negative influence on the variation in wintering distribution for all migrants and for eight migrant feeding guilds. Nearctic migrants travel to Central America to historically-established wintering areas. Coastal areas and forest and shrub vegetation types are important wintering habitats, apparently providing suitable wintering resources in proximity to the breeding grounds. Farther south, in northern South America, migrants may encounter suitable wintering habitat but are also faced with deterrents such as higher numbers of resident species and longer distances to the breeding grounds.

496

Pearce, P.A.; Brun, G.L.;Witteman, J.
Off target fallout of fenitrothion during 1978 forest spraying operations in New Brunswick.
Bull. Environ. Contam. Toxicol. 23:503-508. 1979

KEYWORDS:

ABSTRACT: Not reviewed.

497

Pearce, P.A.; Garrity, N.R.
Impact of aminocarb (Matacil) spraying on forest songbirds in New Brunswick.
Canadian Wildlife Service, Progress Note 121. 19 pp. 1981

KEYWORDS: forest songbirds;spruce budworm control;aminocarb;post-spraying responses;avian populations;management implications

ABSTRACT: The response of forest songbirds to aminocarb (Matacil) sprayed from the air against spruce budworm in northern New Brunswick was investigated in 1977. The insecticide in fuel oil was sprayed twice by TBM aircraft as a dosage of 70 g active ingredient/ha at an interval of about 5 days. That spray regime was employed on about 360 000 ha of forest, or one-fifth of the area treated with insecticides during the control operations. The impact on birds was assessed by surveys of singing males before, between and after the two sprays along walked transects totalling 40 km, by searches for casualties and by checks of nesting activity. The survey showed no convincing evidence of spray effects on songbird populations, no incapacitated birds were observed, and nesting activity continued normally. The results, and studies of bird responses to forest spraying with aminocarb elsewhere in North America, indicate that, at conventional dosages, aminocarb presents no acutely toxic hazard to songbirds.

498

Pearce, P.A.; Peakall, D.B.;Erskin, A.J.
Impact on forest birds of the 1975 spruce budworm spray operation in New Brunswick.
Canadian Wildlife Service, Progress Note. No. 62. 7 pp. 1976

KEYWORDS: forest birds;post-spraying responses;spruce budworm control;spray operations: effects of;phosphamidon;trichlorfon;fenitrothion;aminocarb;mortality;management implications;New Brunswick

ABSTRACT: The impact on breeding birds of a forest spray operation against spruce budworm in New Brunswick in 1975 is assessed by two independent methods: intensive surveys of singing males along walked transects and extensive surveys along motored transects. Extrapolation of data derived from those studies indicates that several million singing male birds, mostly canopy feeders, were killed. Birds feeding on or near the ground were not significantly affected. It seems likely that phosphamidon caused the major portion of the mortality but that fenitrothion was also involved. The application of aminocarb, in a spray format which included fenitrothion, also resulted in significant mortality to canopy feeders. Inadvertent overdosing, resulting from imprecise positioning of spray aircraft, may have contributed locally to the hazard to birds. Spray regimes were more complex and phosphamidon played a greater role in the 1975 operation than in spray programs conducted in the province in preceding years. For those reasons, songbird mortality in 1975 is judged to have been exceptionally and atypically high.

499

Pearce, P.A.; Peakall, D.B.;Erskine, A.J.
Impact on forest birds of the 1976 spruce budworm spray operation in New Brunswick.
Canadian Wildlife Service, Progress Notes. No. 97. 15 pp 1979

KEYWORDS: breeding birds;spruce budworm control;post-spraying responses;phosphamidon;feritrothion;mortality;indicator species;management implications;New Brunswick

ABSTRACT: The impact on breeding birds of a highly complex, 3.9 million-ha forest spray operation against spruce budworm in New Brunswick in 1976 was assessed by surveys of singing males along walked transects totalling 135 km. Effects were variable; a given spray regime would cause mortality and demonstrable changes in the numbers of singing birds in some cases, but not in others. Bird migration concurrent with early stages of the spray operation may have masked the impact on some species. In general, exposed canopy feeders were the most vulnerable. Phosphamidon, used only on about 139000 ha, was very toxic to birds when sprayed by TBM aircraft, but much less so when delivered by C-46 aircraft. The effect of fenitrothion, used on approximately 3.5 million ha, appeared to be significantly greater when sprayed by TBM than when applied at the same dosage, but in a different formulation, by DC-6 aircraft. Aminocarb was monitored only in spray regimes including prior use of either phosphamidon or fenitrothion, but appeared to have little additional impact on birds. Using the Ruby-crowned Kinglet, a canopy feeder, as a key indicator species, we calculated that the 1976 spray operation caused only one-quarter as many bird casualties as did the 1975 spray program in New Brunswick, although spraying covered 40% more territory in 1976. We attribute the markedly reduced impact on birds largely to the near elimination of phosphamidon as an operational larvicide, and possibly to the DC-6 spraying in about one-fifth of the total area treated. Results of roadside surveys of breeding birds conducted on standard routes during the 10-year fenitrothion spray era in New Brunswick indicate no long-term depression of bird numbers, suggesting that the natural resilience of bird populations has compensated for the sometimes substantial, short-term impacts that have been attributed to forest spraying.

500

Pearson, D.L.;
The relation of foliage complexity to ecological diversity of three Amazonian bird communities.
Condor 77:453-466 1975

KEYWORDS: avian diversity;bird-habitat relationships;habitat selection;foraging guilds;tropical forest;Amazon Basin

ABSTRACT: The relation between the complexity of the foliage and the structure of the bird community was compared on three Amazonian forest plots of similar foliage complexity. Predictions made by assuming equilibrium numbers of species in relation to foliage profile were not supported, and expected correlations between foliage complexity and numbers of bird species were not found. Correlations between total number of individuals and total biomass, however, were found. Similar proportions of individual birds on each plot used the same foraging technique. In corresponding vertical strata, there was a significant correlation between the rank order of number of bird individuals using a specific foraging technique on each plot. The vertical biomass distribution was different on the three plots and different degrees of interclass competition was a possible explanation for the difference in bird biomass in the upper strata. The overall structure of the bird communities on the plots was mediated by a combination of (1) structural and energetic limitations inherent in the foliage, (2) historical patterns of foliage and bird distribution, and (3) competitive interactions among the birds and with other animals, especially monkeys.

501

Perkins, C.J.;
Effects of clearcutting and site preparation on the vegetation and wildlife in the flatwoods of Kemper County, Mississippi
Ph. D. Thesis, Miss. St. Univ., State College, Miss. 236 pp. 1973

KEYWORDS: clearcutting;site preparation;vegetation alteration;edge;forest succession;habitat suitability;avian diversity;Mississippi USA

ABSTRACT: This study was conducted on a 33,600 hectare (84,000 acre) tract of land in the Interior Flatwoods of Kemper County, Mississippi, on which intensive forestry practices were being conducted by Weyerhaeuser Company. The study area contained blocks of uncut, second growth pine-hardwood forests, as well as areas that had been clearcut and subjected to varying degrees of site preparation and planted to loblolly pine. During this study these planted pines ranged in age from one to four years. Studies were conducted only on areas that had received the maximum or minimum amount of site preparation. An analysis was made of the vegetation in the overstory, understory, transgressive, seedling, and herbaceous strata of the uncut forest. An importance value was calculated for each vascular species and these values were used to determine phytosociological ranking. Similar analyses were made of the low woody and herbaceous vegetation in the various aged site prepared and planted areas. A study of the usage of the various plant communities by avifauna indicated that the interior of the uncut forest was a suitable habitat for relatively few species of songbirds. Edges of the forests and early seral stages following site preparation attracted many more species as well as individuals. An index made of the ground dwelling, small mammal populations in each of these plant communities indicated that the floor of the forest was very poor habitat for small mammals. Site preparation, however, vastly improved the environment for most species.

502

Perkins, C.J.;
Silvicultural practice impacts on wildlife.
In: Timber-wildlife management symp. Missouri Acad. Sci. Occas. Pap. 3, pp. 43-48. 1974

KEYWORDS: silviculture;forest succession;habitat suitability;clearcutting;site preparation/planting;thinning;monoculture;wildlife: impacts on

ABSTRACT: To understand the effects of silvicultural practices on the habitat of various wildlife species one must first believe that evolutionary forces shaped the original forest community and that the natural forest was a dynamic, ever changing entity comprised of a multitude of successional stages of vegetation with a wildlife community will adapted to each sere. Although silvicultural practices, such as clearcutting, perpetuating monocultures, thinning, and prescribed burning, may seem to create new niches in nature, in reality similar habitats have existed in varying proportions throughout the ages. Therefore, any silvicultural practiced will be temporarily beneficial to certain wildlife species while detrimental to others.

503

Peterson, A.;
Habitat suitability index models: bald eagle (breeding season).
U.S. Depart. Int., Fish and Wildlife Service, National Ecology Center, Biol. Rept. 82(10.126). 25 p. 1986

KEYWORDS: Bald eagle;habitat requirements;habitat suitability index;habitat evaluation;timber harvest;human disturbance;management implications

ABSTRACT: A review and synthesis of existing information were used to develop a Habitat Suitability Index (HSI) model for the bald eagle. The model consolidates habitat use information into a framework appropriate for field application, and is scaled to produce an index between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). HSI models are designed to be used with Habitat Evaluation Procedures previously developed by the U.S. Fish and Wildlife Service.

504

Peterson, B.; Gauthier, G.
Nest site use by cavity-nesting birds of the Caribou Parkland.
Wilson Bull. 97:319-331 1985

KEYWORDS: cavity-nesting birds;cavity-tree characteristics;bird-habitat relationships;habitat selection;univariate analysis;multivariate analysis;mixed-wood forest;British Columbia

ABSTRACT: We studied nest site use by 6 species of cavity nesters in southcentral British Columbia. Discriminant function analysis was performed using nest site characteristics that differed significantly among

4 species (European Starlings, Tree Swallows, Northern Flickers, and Buffleheads.). Cavity volume and, to a lesser extent, entrance area were the most important variables characterizing nest sites. Habitat variables were relatively unimportant except of canopy height, which also explained a significant amount of the variance. The analysis correctly classified only 62% of the cases, reflecting the high overlap in cavity use, especially between Buffleheads and Starlings. We tested the prediction of Erskine and McLaren (1976) that competition for nest sites would increase in this community following its invasion by starlings 30 years ago by comparing nest site characteristics found in this study with similar data collected in 1959. Swallows now use significantly smaller cavities, bluebirds tend to use smaller but deeper cavities, and all species use cavities with a smaller entrance area. It is not clear, however, if these changes resulted from an intensification of competition or from a change in the resource available.

505

Peterson, E.B.; Peterson, N.M.
Summer bird densities in relation to forest types in western North America: annotated bibliography and analysis of literature.
Canadian Wildlife Service, Delta, B.C. 1983

KEYWORDS: avian diversity;avian density;habitat selection;habitat requirements;bird-habitat relationships;logging;forest succession;post-logging responses;land resource maps;management implications;British Columbia

ABSTRACT: *This annotated bibliography and analysis of literature summarizes numerical and functional responses of 24 selected indicator species of non-game forest birds in relation to stand age-class differences resulting from forest harvesting in six biogeoclimatic zones of southwestern British Columbia. Data on bird abundances are reviewed from study sites that encompassed the natural geographic ranges of Sitka spruce, Douglas-fir, ponderosa pine, lodgepole pine, Engelmann spruce and alpine fir--extending from Alaska southeast to California, Arizona and Colorado and from the Pacific Coast inland to the Rocky Mountains. Bird abundance data from this large area are interpreted for their applicability to the portion of British Columbia that lies from the United States-British Columbia boundary north to 51 00 N and from the northwestern tip of Vancouver Island east to 118 00 W. Six of the selected bird species have the potential to increase as a result of forest harvesting practices (Winter Wren, Dark-eyed Junco, Swainson's Thrush, Ruby-crowned Kinglet, Hermit Thrush and Dusky Flycatcher). Nine of the selected species could be expected to decrease as a result of forest harvesting (Chestnut-backed Chickadee, Golden-crowned Kinglet, Townsend's Warbler, Varied Thrush, Western Flycatcher, Hairy Woodpecker, Brown Creeper, Solitary Vireo and Red-breasted Nuthatch). Nine of the selected species cannot be classified as either increasers or decreasers following forest harvesting, either because they appear to be indiscriminant in their use of logged and unlogged areas or because there is inadequate knowledge of their responses (Mountain Chickadee, Red Crossbill, Hammond's Flycatcher, White-breasted Nuthatch, Pine Siskin, Chipping Sparrow, Western Tanger, Yellow-rumped Warbler and Lewis' Woodpecker). Among the selected indicator species, those that appear to be most sensitive to environmental change are Brown Creeper and Townsend's Warbler; those least sensitive ta indicators of environmental change are Dark-eyed Junco and Chipping Sparrow.

506

Peterson, S.R.;
Ecological distribution of breeding birds.
Pp. 22-38 in: D.R. Smith, tech. coord. Proc. of the symposium on management of forest and range habitats for nongame birds. USDA For. Serv. Gen. Tech. Rept. WO-1. 1975

KEYWORDS: avian ecology;avian distribution;avian diversity;breeding birds;management implications;Canada;USA

ABSTRACT: The ecological distribution of breeding birds in the U.S. and southern Canada was analysed using several diversity indices. Average species recorded per route and average species diversity indices calculated with the Shannon-Weiner function were lowest in the West and Southwest and highest in the forested areas of the East and Northeast. Significant differences were noted among strata but little difference was recorded among years. In the central U.S. and Canada, average species per was positively correlated with latitude but the average species diversity index showed no significant correlation. Curves of cumulative species indicated additional species were still being recorded after 168 routes had been sampled. Cumulative species diversity index curves reached an asymptote after about 25 routes were sampled.

507

Petit, D.R.; Petit, K.E.;Grubb, T.C., Jr.
On atmospheric moisture as a factor influencing distribution of breeding birds in temperate deciduous forest.
Wilson Bull. 97:88-96 1985

KEYWORDS: avian distribution;avian diversity;forest diversity;bird-habitat relationships;habitat selection;atmospheric moisture;deciduous forest;Ohio USA

ABSTRACT: *The effect of foliage height diversity and atmospheric moisture on avian community structure and composition was studied on 20 0.8 ha plots of mature deciduous forest in northeastern Ohio. Foliage height diversity was not significantly correlated with avian community structure, while relative humidity showed significant positive correlation with species richness. Food resources for leaf-litter foragers and woodpeckers that forage extensively into dead tree trunks and branches may be intimetely tied to atmospheric moisture. Such a relationship would indicate that the correlation with species richness is directly with food supply and only indirectly with relative humidity. Atmospheric moisture may be a useful indicator of avian community composition within geographically and structurally similar deciduous woodlands.

508

Petty, S.J.;
The management of raptors in upland forests.
Pp. 7-24 in: Jardin, D.C., ed. Wildlife management in forests. 1988

KEYWORDS:

ABSTRACT: not reviewed

509

Pimentel, D.;
Ecological effects of pesticides on non-target species.
US. Gov't Printing Office, Washington, DC. 220 p. 1971

KEYWORDS:

ABSTRACT: not reviewed

510

Pinowski, B.C.;
Use of tree cavities by nesting eastern bluebirds.
J. Widl. Manage. 40: 556-563. 1976

KEYWORDS: eastern bluebirds;cavity-tree characteristics;habitat selection;snags;management implications;Michigan USA

ABSTRACT: Tree cavities used by nesting eastern bluebirds were described and compared for two study areas to assess the effects of different land use practices and competition for the nest sites with other species. All but 2 of 98 nest cavities were located in dead trees or dead limbs; 71.5 percent of the nests were located in pines or oaks. Abandoned woodpecker nest cavities accounted for 77.6 percent of the cavities used, and management procedures beneficial to most woodpecker species are, therefore, also beneficial to bluebirds. Even-aged management and extensive removal of dead trees are detrimental to bluebirds.

511

Plunkett, R.L.;
The importance of birds in forest communities.

Pp. 4-8 in: R.M. DeGraaf and K.E. Evans, tech. coord. Management of north central and northeastern forests for nongame birds. Workshop Proc., Jan 23-25, 1979, Minneapolis, Minnesota. USDA For. Serv. Gen. Tech. Rept. NC-51. 1979

KEYWORDS: forest communities;birds:importance of;indicator species;bird-habitat relationships;ecosystem management;management implications

ABSTRACT: The usefulness of bird populations as monitors of the diversity of natural biological communities and to provide feedback to the manager as to the results of management programs is reviewed. Certain characteristics that contribute to the usefulness of birds as indicator species are discussed, and the need for reorientation toward ecosystem management in place of single-species management in place single-species management is stressed.

512

Probst, J.R.;
Oak forest bird communities
Pp. 80-88 in: R.M. DeGraaf and K.E. Evans, tech. coord. Management of north central and northeastern forests for nongame birds. Workshop Proc., Jan 23-25, 1979, Minneapolis, Minnesota. USDA For. Serv. Gen. Tech. Rept. NC-51. 1979

KEYWORDS: avian ecology;avian diversity;avian density;avian succession;;forest succession;forest management;silviculture;thinning;rotation age;single tree selection;management implications;oak forests

ABSTRACT: Oak forests represent the largest forest type in the United States. The density and diversity of avian species in oak forests are dependent on habitat factors such as vegetation structures and successional stage. Therefore, they are greatly affected by management considerations such as cutting, thinning, rotation age, stand size, and tree species composition. The species number and population sizes of breeding birds and winter birds are considered.

513

Probst, J.R.;
Kirtland's warbler breeding biology and habitat management.
Pp. 28-35 in: T.W. Hoekstra and J. Capp, compilers. Integrating Forest Management for Wildlife and Fish. USDA North Central For. Exp. Stn. NC-122. 63 pp. 1988

KEYWORDS: Kirtland's warbler;endangered species;breeding biology;habitat requirements;biogeography;habitat/forest management;management implications;conservation measures;Michigan USA

ABSTRACT: The Kirtland's warbler is an early succession, area sensitive species seldom found in stands smaller than 30 to 40 ha. This warbler occupies dense jack pine stands where trees are from 6 to 23 years old and from 1.7 to 5.0 m high growing on poor, sandy soils. Typically, it has been found in areas regenerated naturally by serotinous cones resulting from wildfires. In the past 2 decades, however, Kirtland's warblers have been found in naturally regenerated, unburned jack pine and in densely stocked pine plantations. Stands are managed on a 50 year rotation and clustered into discrete management areas. Extensive dispersal to find suitable habitat reduces breeding opportunities. Currently, about 15% of the males abandon territories, and about 15% of the resident males do not find mates. Clustering stands into management units and staggering the schedule of stand regeneration should minimize biogeographic dispersal problems. Because Kirtland's warblers colonize patches of taller, dense jack pine before they occupy habitat with shorter or less dense trees, the period of Kirtland's warbler occupancy in a management area can be extended by several methods such as varying tree spacing in a plantation. Researchers and managers have developed a variety of harvest options, site preparation methods, and pine regeneration alternatives for providing suitable Kirtland's warbler habitat. Several options do not require the use of prescribed fire. These management alternatives must not only provide suitable tree stocking and spacing for the Kirtland's warbler but also accommodate their spatial and temporal needs such as the size, chronology, and age diversity of stands.

514

Ralph, C.J.; Scott, J.M., eds.
Estimating numbers of terrestrial birds.
Studies in Avian Biology No. 6. 630 p. 1981

KEYWORDS: terrestrial birds;bird census;census methods;number estimations

ABSTRACT: *There are many methods now used to estimate bird numbers. The methods vary considerably in their preciseness and accuracy. However, there are three things common to all: observers to count, birds to be counted, and habitats to be surveyed. How variations in methods, observers, training of observers, and other environmental variables all affect the accuracy and precision of bird counts must be known and assessed if the field is to progress. In reading the papers in these proceedings, you will find a good many differences in opinion. It was our intent to bring together diverse points of view. You will also find a large gap between the state of the art and actual field practices. It is our hope that the papers in this book will serve to highlight these differences and motivate the field biologists to close the gap.

515

Ramsden, D.J.; Lyon, L.J.;Halvorson, G.L.
Small bird populations and feeding habitats-Western Montana in July.
Am. Birds 33:11-16 1979

KEYWORDS: bird-habitat relationships;avian density/biomass;predictive model;population changes;clearcuts;Montana USA

ABSTRACT: *The study reported here was conducted during July 1976, in a montane forest area in western Montana. Objectives were: 1) To determine avian occupancy densities and biomass in different habitats, and 2) To develop a preliminary model for predicting small bird populations and changes in these populations resulting from typical timber harvest practices.

516

Ranney, J.W.; Bruner, M.C.;Levenson, J.B.
The importance of edge in the structure and dynamics of forest islands.
Pp. 67-95. In: R.L. Burgess and D.M. Sharpe, eds. Forest Island Dynamics in Man-Dominated Landscapes. Springer-Verlag, New York. 1981

KEYWORDS: forest edge;edge structure/dynamics;edge composition;edge effects;modeling;management implications

ABSTRACT: **Issues regarding the identification of edge processes are addressed by field and simulation studies in this chapter. Topics covered include: 1) general edge characteristics; 2) patterns in species distributions; 3) forest edge structural dynamics; 4) possible edge effects on regional forest composition; 5)effects of edge on forest island development.

517

Raphael, M.G;
Utilization of standing dead trees by breeding birds at Sagehen Creek, California.
Ph.D. Thesis, Univ. Calif., Berkeley. 195 p. 1980

KEYWORDS: cavity-nesting birds;avian diversity;avian density;foraging behaviour;fire: burned plot;snags;snag dynamics;management implications;California USA

ABSTRACT: I studied populations of cavity nesting birds (CNB) and standing dead trees (snags) in an east-side Sierra Nevada pine-fir forest during spring and summer from 1975 to 1979 and located 561 active nests of 18 CNB species. Multivariate comparisons of stand characteristics on plots surrounding nests separated species nesting in burned forest from those nesting in unburned forest. Compared to random plots, nest plots had greater numbers of large diameter snags. Overall, 72% of the active nests were in snags while only 7% of the available trees were snags. Sapsuckers nested most often in dead tops of live trees; all other species nested preferentially in snags. I defined 6 tree decay categories ranging from sound to decayed and observed marked interspecific differences in decay state preferences, although as a group birds used all states in expected numbers. Nest trees were significantly larger in diameter, had more bark, and were more often broken-topped than non-nest trees. Bird species segregated large diameter trees on the basis of tree height; interspecific variation in nest hole height reflected these differences in tree heights. Potential competition for nest trees exists between two sapsucker species; all other bird species nested either in trees with different characteristics, or in different forest types. Bird species nesting in the most similar trees nested in burns where nest sites are not limiting. I recorded 1026 observations of the foraging behavior of 10 bird species. All species except brown creepers and pygmy and red-breasted nuthatches foraged on snags more often than expected. Birds preferred to forage on trees 23-53 cm dbh; this size class may provide maximum energy intake. Morphologically similar species tended to feed at different heights within trees. Differences in foraging method, rather than differences in microhabitat, were most responsible for foraging segregation among the birds. On a burned plot, 81% of all snags fell within 15 years following the burn. Fir snags stood an average of 5 years longer than pines, and larger diameter trees stood longer than smaller diameter trees. Tree mortality on unburned plots was random with respect to diameter but mortality of Jeffrey pine was higher than expected. Cavity nesting bird density increased with increasing snag density. CNB density declined 77% after snag removal on a burned plot, but 2 CNB species nested in remaining stumps. Density of CNB varied from 19 to 65 pairs per 40 ha on 6 other plots, and was most strongly correlated with density of snags greater than 38 cm dbh. CNB density was not correlated with live vegetation variables. Yearly changes in CNB density from 1966 to 1979 were highly negatively correlated with annual precipitation. Precipitation or related weather factors apparently influences CNB density through overwinter mortality, suggesting that winter habitat is of critical importance. I estimate that 423 suitable soft snags (15 years or older) per 40 ha are required to support maximum bird densities on burned forests and that 4 hard snags are required to produce 1 soft snag. On unburned forests, 342 snags (one third hard) are required per 40 ha. Snag suitability is determined by diameter, bark cover, and top condition. Snags should be managed in dispersed clumps rather than isolated individuals to meet nesting and feeding preferences. Providing sufficient numbers of large-diameter snags on managed stands will require retention of trees or selected stands beyond the economic rotation period. Selected overstory or residual trees can be retained or killed to provide snags under even-aged harvest systems; retention of old-growth stands is recommended to provide habitat for species requiring very large diameter trees. Recommendations for future research emphasize winter habitat studies and more detailed nesting and foraging studies.

518

Raphael, M.G.;
Cavity-nesting bird response to declining snags on a burned forest: a simulation model.
Pp. 211-215 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99.
1983

KEYWORDS: fire;snag densities;cavity-nesting bird responses;snag harvest;simulation model;management implications

ABSTRACT: I present a simple model to estimate population sizes of primary (PCN) and secondary (SCN) cavity nesting birds in relation to a declining snag population following fire. The model assumes that PXN are limited by snag suitability, intraspecific territoriality, or snag density during successive time periods. Two examples illustrate these patterns, as well as the impact of snag harvest on subsequent bird populations. A FORTRAN program, CNBIRDS, performs all computations.

519

Raphael, M.G.;
Wildlife populations in relation to stand age and area in Douglas-fir forests of northern California.
Pp. 259-274 in: W.R. Meehan, T.R. Merrell, Jr., and T.A. Hanley, eds. Proceedings of a symposium on fish and wildlife relationships in old-growth forest. American Institute on Fishery Research Biologists Northwest Section, The Wildlife Society Alaska Council on Science and Technology held in Juneau, Alaska, 12-15 April 1982.
1984

KEYWORDS: avian ecology;avian diversity;avian density;foraging behavior;old-growth forest;forest succession;forest size;management implications;Douglas-fir;California USA

ABSTRACT: Preliminary findings are presented from the first year of a 3 year field study of wildlife populations on 136 plots located within 46 Douglas-fir stands varying from 50 to 350 years old and from 5 to 450 ha. in area. Wildlife abundance was estimated using variable circular-plot bird censuses; pitfall traps for small mammals (primarily insectivores), reptiles, and amphibians; live-trap grids for small mammals; baited track-stations for larger mammals; and intensive searches for amphibians. Vegetation and wildlife data were compared among 3 stand age-classes (sawtimber, <150 years; mature, 150-250; and old-growth, > 250), and 5 stand size-classes, averaging about 10, 25, 50, 100, and 200 ha. Vegetation analysis showed significant differences among the 3 age classes; differences among bird, mammal, and herp communities were less distinct. Based on comparisons of richness and relative abundance of wildlife species, old growth differed from sawtimber but not from mature stands. Density estimate of 17 bird species, 4 salamanders, and 10 mammals were positively correlated with stand age. An analysis of the effects of stand area showed that more wildlife species were found in larger stands, but this increase could be explained by the greater sampling effort in those stands. Species richness of large stand could be explained by the greater sampling effort in those stands. Species richness of large stands could be duplicated by combining species found in a random assemblage of 10 ha. stands. Some wildlife species were not found in the smallest stands; management for these species cannot rely on retention of only small reserves. I identified 10 species which are more abundant in both older and larger stands. These species should be studied further to determine their true dependency on old growth.

520

RAPHAEL, M.G.; White, M.
Snags, wildlife, and forest management in the Sierra Nevada.
Cal-Neva. Wildl. 1978:23-41 1978

KEYWORDS:

ABSTRACT: not reviewed

521

Raphael, M.G.; White, M.
Use of snags by cavity-nesting birds in the Sierra Nevada.
Wildl. Monogr. No. 86. 66 pp 1984

KEYWORDS: snags;cavity-nesting birds;cavity tree characteristics;nest-site selection;foraging behaviour;avian density;management implications;California USA

ABSTRACT: We studied nesting and foraging habitat selection by cavity-nesting birds (CNB) in burned and unburned Sierra Nevada forests during spring and summer from 1975 through 1979. We located 561 active nests of 18 CNB species, including 9 excavators. Characteristics of nest trees were compared among bird species and to a sample of available trees using univariate and multivariate analyses. Overall, 72% of the nests were in standing dead trees (snags), whereas only 7% of available standing trees were dead. Compared to available trees, nest trees were larger in diameter, surrounded by a larger number of snags > 23 cm diameter at breast height (dbh), had more bark cover, and were more often broken-topped white fir. Diameter was the most consistently important difference observed between nest trees and trees available to each bird species. Comparisons of nest sites among bird species showed that tree height varied most. Interspecific differences in nest hole height were completely explained by these tree height differences. Bird species also differed in their preferences for tree decay-states. Bark-gleaning species tended to nest in well-decayed, softer snags; timber-drilling species nested in sounder snags. These differences suggested that little interspecific competition for nest sites occurred in this bird community. Two sapsucker species may have competed because their nesting habitat and preferred trees were similar; all other species used different kinds of trees or nested in different habitat types. Most (67%) of the nest cavities occupied by nonexcavators were created by excavators (woodpeckers and nuthatches). Brown creepers did not depend on excavators for holes and chose trees that were different from those of other CNB. We recorded 1,026 foraging behaviour observations of 10 bird

species. All species except brown creepers and pygmy nuthatches and red-breasted nuthatches foraged on snags more often than predicted from snag availability. Birds preferred to forage on trees 23-53 cm dbh; morphologically similar species tended to feed at different tree heights. However, differences in foraging method, rather than differences in microhabitat, were more responsible for foraging segregation. Cavity-nesting bird density increased in proportion to snag density of 7 study plots. CNB density declined 77% after snag removal on a burned plot, but 2 CNB species nested in remaining stumps. Density of CNB varied from 19 to 65 pairs per 40 ha on 6 other plots and was most strongly correlated with density of snags > 38 cm dbh. CNB density was not correlated with any live vegetation variable. Yearly changes in CNB density from 1966 through 1979 were highly negatively correlated with annual precipitation. Winter weather apparently influenced density through direct mortality or by inducing movements to or from the study plots, suggesting that winter habitat may be critical. We estimated that 423 suitable soft snags (15 years or older) per 40 ha were required to support maximum bird densities on burned forests and that 4 hard snags were required to produce 1 soft snag. On unburned forests, 342 suitable snags (one-third hard) were required per 40 ha. Snag suitability could be predicted using diameter, bark cover, and top condition. Snags should be managed as dispersed clumps rather than as isolated individuals to meet nesting and feeding requirements. Providing sufficient numbers of large-diameter snags on managed stands often will require retention of trees and selected stands beyond the usual rotation period of retention of existing patches of old-growth timber. Recommendations for future research emphasize winter habitat studies and more detailed nesting and foraging studies.

522

Rappole, J.H.; Morton, E.S.
Effects of habitat alteration on a tropical avian forest community.
Pp. 1013-1022 in: Buckley, P.A. et al. eds., Neotropical Ornithology. AOU Monograph No. 36, Allen Press, Laurence, Kansas. 1985

KEYWORDS:

ABSTRACT: not reviewed

523

Rappole, J.H.; Morton, E.S.;Lovejoy, T.E.;Rous, J.L.
Nearctic avian migrants in the Neotropics.
Washington, DC., US Depart. Interior, Fish and Wildlife Service. 1983

KEYWORDS:

ABSTRACT: not reviewed

524

Rasmussen, W.O.; Ffolliott, P.F.
A model to predict snag development.
Wildlife Society Bulletin 11: 291-292. 1983

KEYWORDS: snags;techniques: modelling;snag development;management application

ABSTRACT: Southwestern ponderosa pine snags are important habitat components for cavity-nesting wildlife. As part of an assessment of snag management policies and their effects on timber harvests, a user-oriented computer simulation model was written to estimate tree mortality and snag retention. The model, called SNAG, is written in FORTRAN IV in an interactive mode. Computer memory requirements are small, requiring less than 5,000 word of storage. SNAG is currently operational on the DEC-10 computer at the University of Arizona, Tuscon, and can be adapted for use with small, programmable calculators.

525

Recher, H.;

Bird species diversity and habitat diversity in Australia and North America.
Am. Nat. 103: 75-80. 1969

KEYWORDS: avian diversity;avian density;bird-habitat relationships;forest diversity;North America;Australia

ABSTRACT: *Censuses of breeding bird populations in Australia support the conclusion reached in North American studies, that habitat diversity as measured by foliage profile is a good predictor of bird species diversity. The data also indicate that the avifauna of forest and scrub habitats in the temperate zones of Australia and North America have reached equilibrium and are probably saturated. Equilibrium or saturation levels appear to be independent of the histories and ancestories of the avifauna concerned.

526

Repenning, R.W.; Labisky, R.F.
Effects of even-age timber management on bird communities of the longleaf pine forest in northern Florida.
J. Wild. Manage. 49:1088-1098 1985

KEYWORDS: even-aged timber management;logging;plantations;avian diversity;avian density/biomass;breeding bird communities;wintering birds;management implications;Florida USA

ABSTRACT: Breeding and wintering bird populations were studied, by line-transect sampling, in the natural longleaf pine forest and four age-classes (1, 10, 24, and 40 years) of slash pine plantations in Florida, during 1981. Breeding bird density, species richness, species diversity, and biomass were highest in the longleaf pine forest and differed ($P<0.05$) from those found in all age-classes of slash pine plantations. Breeding bird density, species richness, and diversity (H'), but not biomass, were correlated ($P<0.05$) with stand age. Little similarity in the composition of the breeding bird community existed between longleaf pine and any age-class of slash pine plantation. In winter, neither species richness nor diversity differed ($P>0.05$) among the five stand types, and density and biomass differed ($P<0.05$) only between 1 and 24 year old plantations. Similarity of the wintering bird community between the forest and plantations increased progressively with plantation age. Although slash pine plantations in northern Florida do not provide habitat that will maintain the breeding bird community of the natural longleaf pine forest, older plantations (>40 years) do provide habitat for a wintering bird community that is reasonably similar to that of the natural longleaf pine forest.

527

Reynolds, R.T.;
Management of western coniferous forest habitat for nesting accipiter hawks.
USDA For. Serv., Rocky Mtn. For. and Range Exp. Stn., Gen. Tech. Rep. RM-102. 7pp. 1983

KEYWORDS: accipiter hawks;nest sites;breeding birds;habitat selection;bird-habitat relationships;coniferous forest;management implications;Oregon USA

ABSTRACT: The sharp-shinned hawk, the Cooper's hawk, and the northern goshawk, have such specific nesting habitat requirements that they are vulnerable to changes in forest stands resulting from timber harvesting. To maintain populations of these species in western conifer forests, the following recommendations are proposed: 1) Uncut areas of approximately 4, 6, and 8 ha should be left around active nests for the sharp-shinned, Cooper's and goshawk, respectively. 2) Because of tree growth and associated changes in the vegetative structure of nest sites, management of accipiter habitat must consider the turn-over of nest sites. Prospective replacement nest sites within the home range of each pair should be selected and maintained accordingly. 3) Active and prospective nest sites should not be precommercially or commercially thinned, because this will result in reduced stand densities and deeper tree crowns. 4) To maintain nesting densities of the three Accipiter species equal to that found in Oregon, currently suitable nest sites should be provided at the following approximate densities: 20 sites per township (36 square miles, 9,324 ha) for sharp-shinned hawks, 5 per township for Cooper's hawks, and 4 per township for goshawks. 5) Further study should be oriented towards: (1) estimating the density of these species in other localities where forestry is changing the structure of forest stands, (2) confirming the suggested size and shape of uncut areas around nest sites, and (3) determining, with telemetry, the size and shape of home ranges, the types of habitats included within ranges, and the extent to which these habitats are used for foraging by these hawks.

528

Reynolds, R.T.; Linkhart, B.D.;Jeanson, J.
Characteristics of snags and trees containing cavities in a Colorado conifer forest.
USDA Forest Service, Rocky Mount. For. and Range Exp. Stat., Res. Note RM-455. 6 pp. 1985

KEYWORDS: snags;cavity-tree characteristics;snag management;coniferous forest;Colorado USA

ABSTRACT: In Colorado a 160-ha forest of mature ponderosa pine--Douglas-fir contained 6.5 snags and spike-top trees per hectare. Of these, 0.9 per hectare had one or more cavities. In addition, there were 0.4 live cavity-trees per hectare. Most snags and spike-tops that contained cavities were in the larger diameter classes. The proportion of snags with cavities was equal among ponderosa pine, Douglas-fir, limber pine, and quaking aspen.

529

Reynolds, R.T.; Scott, J.M.;Nussbaum, R.A.
A variable circular plot method for censusing birds.
Condor 82:309-313 1980

KEYWORDS: bird census;variable circular-plot method;avian density;management implications

ABSTRACT: A bird census method is presented that is designed for tall, structurally complex vegetation types, and rugged terrain. With this method the observer counts all birds seen or heard around a station, and estimates the horizontal distance from the station to each bird. Count periods at stations vary according to the avian community and structural complexity of the vegetation. The density of each species is determined by inspecting a histogram of the number of individuals per unit area in concentric bands of predetermined widths about the stations, choosing the band (with outside radius x) where the density begins to decline, and summing the number of individuals counted within the circle of radius x and dividing by the area. Although all observations beyond radius x are rejected with this procedure, coefficients of detectability may be determined for each species using a standard fixed maximum distance.

530

Rice, J.; Anderson, B.W.;Ohmart, R.D.
Comparison of the importance of different habitat attribute to avian community organization.
J. Widl. Manage. 48: 895-911. 1984

KEYWORDS: avian community;avian diversity;habitat selection;forest structure;forest diversity;bird-habitat relationships

ABSTRACT: We investigated the possible importance of individual tree species in avian habitat selection by comparing tree species contributions to contributions of horizontal and vertical patchiness and density of vegetation. Individual bird species responded with greater frequency to member of particular species of trees than to any variables depicting structure. We conclude that many of the commonly found correlations of bird community relationships to vegetation profiles may be the result of combining analyses of many different bird species with many different tree of plant species associations. We strongly recommend that studies of avian habitat use include measures of trees species composition of the sites even if foliage profile or density measures alone provide statistically significant results.

531

Richmond, M.L.; Henny, C.J.;Floyd, R.L.;Mannan, R.W.;Finch, D.M.;DeWeese, L.R.
Effects of sevin-4-oil, dimilin, and ortheno on forest birds in northeastern Oregon
USDA For. Serv. Res. Pap. PSW-148, Pacific Southwest For. and range Exp. Stn., Berkeley, Calif. 19 p. 1979

KEYWORDS: forest birds;insecticides: effects of;sevin-4-oil (carbaryl);orthene (acephate);dimilin (diflubenzuron);brain cholinesterase;Oregon USA

ABSTRACT: *A field study begun in 1975 in the forests of northeastern Oregon was designed to assess the effects of Dimilin (at 0.14 and 0.28 kg/ha), Sevin-4-Oil (at 2.24 kg/ha), and Orthene (at 1.12 and 2.24 kg/ha) on a nontarget nesting bird population. Eleven study plots (six treatment and five control plots) were established in the Wallowa-Whitman National Forest. Breeding bird density, species diversity, nesting success, brain cholinesterase (ChE) activity, and the presence of sick or dead birds were evaluated on control and treatment plots during the study period in the year of spraying (1976) and 1 year after spraying. Two bird census techniques were used (spot-mapping and fixed station index). Calculations of the probability of success of nest contents were based on nest-days of exposure to allow use of incomplete nest records. Because organophosphate and carbamate insecticides like Orthene and Sevin-4-Oil inhibit cholinesterase enzymes, we measured brain ChE activities of collected birds to determine the extent and magnitude of exposure to the insecticides. We did not find any sick or dead birds, or observe any abnormal behavior in birds on plots treated with Dimilin or Sevin-4-Oil. Furthermore, cholinesterase tests of birds from plots treated with Sevin-4-Oil showed only 2 of 55 birds with brain ChE depression. However, several observations of abnormal activity in forest birds were made following the application of Orthene. In marked contrast to Sevin-4-Oil, Orthene caused extensive inhibition of brain ChE activity (commonly 30 to 50%) for up to at least 33 days for 11 of 12 species collected. The highest frequency of depression (12 out of 13 birds or 92%) was noted on the second day following spray. Postspray bird census data suggest that two species of birds may have decreased in numbers following the Orthene treatment. The overall impact of Orthene on the nesting bird population is not fully understood and further testing is necessary. One year postspray, 11 birds (6 species) were collected on the plot treated with Orthene at 1.12 kg/ha and the brain ChE activity from all samples was within the normal range.

532

Richter, J.;
The commercial forest as (an avian) breeding biotope
Allgemeine Forstzeitschrift 8:191-192 1980

KEYWORDS:

ABSTRACT: not reviewed

533

Roach, B.A.;
Scheduling timber cutting for sustained yield of wood products and wildlife.
USDA For. Serv. Gen. Tech. Rep. NE-14. 1974

KEYWORDS: forest management;timber harvest;even-aged stand;habitat suitability;forest size;forest diversity;rotation periods;wildlife

ABSTRACT: Providing relatively uniform yields of hardwood timber for future generations will require adjustment of the presently unbalanced age-class distribution in the eastern hardwood forests. Because the home ranges of most species of wildlife are relatively restricted, maintaining stable wildlife populations throughout these forests will require adjusting and regulating timber age classes by much smaller units of land (several hundred to several thousand acres) than would be needed for sustained yield of timber alone. It is commonly believed that regulating timber production by small unit has an age-class distribution approaching the average distribution for the forest as a whole, cost increases should be insignificant. The key to successful regulation of timber age classes for combined timber and wildlife production, with minimum impact on costs and timber yields, is in the long-term planning of cutting schedules for small units of land.

534

Robbins, C.S.;
Census techniques for forest birds.
Pp. 142-163 in: R.M. DeGraaf, tech. coord. Proc. of the Workshop: management of southern forests for nongame birds. Jan 24-26, 1978, Atlanta, Georgia. 1978

KEYWORDS: forest birds;technique: census;spot mapping;transects;breeding bird survey

ABSTRACT: The spot-mapping method is generally acknowledged to be the most dependable of the several census methods for forest birds in the breeding season. Transects and point counts, especially when well standardized and corrected for biases, may be preferable if large areas must be sampled in a short period of time.

535

Robbins, C.S.;
Effect of forest fragmentation on bird populations.
Pp. 198-212 in: R.M. DeGraaf and K.E. Evans, tech. coord. Management of north central and northeastern forests for nongame birds. Workshop Proc., Jan 23-25, 1979, Minneapolis, Minnesota. USDA For. Serv. Gen. Tech. Rept. NC-51. 1979

KEYWORDS: forest size;forest fragmentation;avian ecology;breeding birds;forest management;management implications;snags;reservoirs;corridors

ABSTRACT: Many of the insectivorous songbird species that winter in the tropics are dependent on large unbroken tracts of forest during the breeding seasons. These species are disappearing from localities where forests are becoming fragmented. By long-range planning, managers can prevent local extinctions of these area-sensitive birds through use of such techniques as management in large units, retention of connecting corridors, and prevention of excessive isolation of forest fragments. Edge conditions can be provided, where appropriate to meet the needs of upland game species.

536

Robbins, C.S.; Dawson, D.K.;Dowell, B.A.
Habitat area requirements of breeding forest birds of the middle Atlantic States.
Wild. Monogr. 103:1-34 1989

KEYWORDS: breeding forest birds;habitat requirements;nesting requirements;forest fragmentation;forest structure;bird-habitat relationships;avian distribution;avian abundance;migratory status;management implications;conservation implications;Mid-Atlantic States USA

ABSTRACT: Conservation of birds requires an understanding of their nesting requirements, including area as well as structural characteristics of the habitat. Previous studies have shown that many neotropical migrant bird species seem to depend on extensive forested areas, but the specific area requirements of individual species have not been clarified sufficiently to aid in design and management of effective preserves. For this 5-year study, bird and vegetation data were obtained at 469 points in forests ranging in area from 0.1 ha to more than 3000 ha in Maryland and adjacent states. Data were analyzed first by stepwise regression to identify habitat factors that had the greatest influence on relative abundance of each bird species. In the relatively undisturbed mature forests studied, degree of isolation and area were significant predictors of relative abundance for more bird species than were any habitat variables. For species for which forest area was a significant predictor of abundance, we used logistic regression to examine the relationship between forest area and the probability of detecting the species. In managing forest lands for wildlife, top priority should go toward providing for the needs of area-sensitive or rare species rather than increasing species diversity per se. Avian species that occur in small and disturbed forests are generalists that are adapted to survival under edge conditions and need no special assistance from man. Forest reserves with thousands of hectares are required to have the highest probability of providing for the least common species of forest birds in a region. However, if preservation of large contiguous forest tracts in not a realistic option, results of this study suggest 2 alternative approaches. First, if other habitat attributes also are considered, smaller forests may provide suitable breeding sites for relatively rare species. Second, smaller tracts in close proximity to other forests may serve to attract or retain area-sensitive species.

537

Robbins, C.S.; Erskine, A.J.

Population trends in nongame birds in North America.
Trans. North. Am. Wildl. Nat. Resour. Conf. 40:288-293 1975

KEYWORDS: nongame birds;population trends;bird survey data;avian diversity;biogeography;North America

ABSTRACT: *Analyses have shown that Breeding Bird Survey data are remarkably consistent from year to year, that the physiographic regions that are used as a basis for stratifying the results for computer analysis are valid sub-divisions, and that both species totals and species diversity indices remain quite constant over a period of years within the same physiographic region. As would be expected, the average number of species per 50 stop route is lowest in the deserts and high plains of the western United States and in the Great Valley of California and increases eastward and northward until reaching a peak in the northern hardwood and spruce hardwood forests. Similarly, the species diversity index (H' of Shannon and Weaver 1963) is lowest in the same areas of the southwest and increases northward and eastward. This index reaches its highest value in the Cumberland Plateau of Tennessee and Kentucky, followed closely by the northern hardwood forests, the Adirondack Mountains, and the Ozark Mountains. In addition to providing information on a nation-wide and continent-wide scale, the Breeding Bird Survey fills ever increasing local needs for bird population information. The same methods have been applied more intensively on a local scale when there was a need to assess bird populations for a particular project and compare the results with a regional or continental standard.

538

Roble, R.J.; Browning, N.G.
Comparative use of woody plantings by nongame birds in Kansas.
Wildl. Soc. Bull. 9:141-143 1981

KEYWORDS: woody plantings;bird-habitat relationships;habitat selection;habitat alteration;foraging behaviour;avian diversity;avian status;management implications;Kansas U.S.A.

ABSTRACT: *Plantings of woody vegetation on a 0.8 ha plot in northern Kansas were evaluated with time budgets of year-round bird activity. Granivorous birds used the vegetation more than insectivores. Approximately 51% of all bird activity occurred in plantings of 4 woody species and 15 plantings each amassed 1% or more of the recorded bird activity; plantings of 18 woody species attracted little use. Bird usage of the plot, and individual plantings in the plot, varied with season. Plantings of thornless multiflora rose, multiflora rose, cardinal autumnolive, and manchu cherry 1 were heavily used by nongame birds during this study. Evaluations of the sort described in this study can help develop better habitat improvement programs for nongame wildlife.

539

Roe, N.A.;
Birds and disturbed forest succession after logging in Pacific Rim National Park, Vancouver Island, British Columbia and a contribution towards the development of an interpretive plan for logged areas.
M.Sc., University of Calgary. 202 p 1974

KEYWORDS: logging;site preperation;plantations;forest succession;post-logging response;avian succession;avian diversity;avian density;management implications;coniferous forest;British Columbia

ABSTRACT: The relationships between birds and forest succession after logging were studied during the summer season of 1972 in the coastal Western Hemlock zone of Krajina (1965) in Pacific Rim National Park on the west coast of Vancouver Island, British Columbia. Birds were counted at eight sites representing five stages of forest succession along transects totalling 800 metres in length in each stage. The stages were as follows: (1) 2 years old - logged in 1970, not planted and supporting no tree growth (two transects of 400 m); (2) 8 years old- logged in 1964, burned and planted with Douglas fir, grand fir, and a few sitka spruce, with western hemlock and western red cedar also present (one 800 m transect); (3) 12 years old - logged in 1960, burned, and planted with Douglas fir, with western hemlock and western red cedar also present (two transects of 400 m); (4) 24 years old - logged in 1948, not planted but supporting growth of western hemlock, western red cedar and red alder (one 800 m transect); (5) mature forest with no history of logging, consisting of western hemlock, western red cedar and Pacific silver fir (two transects of 400 m). Transect counts of birds were supplemented by a spot-mapping method. The area surveyed was 0.8 ha per successional stage in both methods. Results from both methods were converted into biomass figures using standard weights of each species. Collected field data on each major vegetation species was analysed for each successional stage in order to assemble a description of the structure and composition of the habitat. The seperate stages and different types of forest succession contained bird populations that were different. Biomass of birds was greatest in the 24 year unplanted stage, and least in the mature forest stage. Bird species diversity was greatest in the 8 year planted stage, and least in the 2 year unplanted stage. The 12 year planted stage had a low biomass and an intermediate species diversity of birds. Increases in biomass were highly positively correlated with increases in canopy coverage by red alder, and with increases in the number of ground cover species. Increases in bird species diversity were highly positively correlated with increases in the number of tree species. These relationships suggest that monocultural plantations reduce the productivity (expressed in biomass) of birds in forest succession. The species diversity and abundance of birds found in this study are compared with those of other biotypes, and in relation to the history of the study area. Speculation is made on future trends in bird populations in the study area. The implications for silviculture, forest and park management are discussed. An interpretive plan is developed for use by park visitors when studying birds in relation to forest succession.

540

Roppe, J.A.;
Effects on wildlife of a fire in a lodgepole pine forest.
M.S. Thesis, Colorado State Univ., Fort Collins. 100 pp 1973

KEYWORDS:

ABSTRACT: nor reviewed

541

Roppe, J.A.; Hein, D.
Effects of fire on wildlife in a lodgepole pine forest.
Southwest. Nat. 23:279-288 1978

KEYWORDS: fire: wild;post-fire responses;avian diversity;avian density/biomass;lodgepole pine;Colorado USA

ABSTRACT: Effects of a subalpine wildfire on populations of wildlife in north-central Colorado were investigated 8 years after the burn. Inventories of birds and mammals were compared on the 190-ha burn with those from an adjacent similar site of lodgepole pine in 1974. Species diversity for birds and small mammals was greater on the burn than in the adjacent lodgepole. Species composition of both birds and mammals was different in the two habitats, but population densities of birds and small mammals were not significantly different in the two habitats in summer. Mule deer and elk used the burn more than the lodgepole during winter. Estimated values of total biomass for all birds and mammals were similar for both habitats.

542

Rosenburg, D.K.; Fraser, J.D.;Stauffer, D.F.
Use and characteristics of snags in young and old forest stands in southwest Virginia.
For. Sci. 34:224-228 1988

KEYWORDS: snag characteristics;snag use;foraging substrate;old-growth forest;model: log-linear;management implications;Virginia USA

ABSTRACT: Snags were sampled in chestnut oak and oak-hickory stands in southwest Virginia. More large (>= 17 cm dbh) snags were found in stands >= 100 years of age and more small (<= 10 cm dbh) snags were found in stands < 80 years of age, than expected under the model of equal distribution among age classes (x sq = 25.3, df = 6, P = 0.0003). Log-linear models suggested that large diameter snags are more likely to be used by foraging birds than smaller snags. Tall snags were also used more than short ones, but 4-way log-linear models suggested that this was a result of a positive dbh-height relationship, rather than a reflection of bird selection of tall snags. Similarly, cavities were found more often than expected in large dbh trees.

543

Rotenberry, J.T.; Wiens, J.A.
A synthetic approach to principal component analysis of bird/habitat relationships.
Pp. 197-208 in: D.E. Capen, ed. The Use of Multivariate Statistics in Studies of Wildlife Habitat. USDA For. Serv. Gen. Tech. Rep. RM-87. 1981

KEYWORDS: techniques;principal component analysis;bird-habitat relationships;vegetation structure;density contours;gradient analysis

ABSTRACT: The application of principal components analysis (PCA) to bird/habitat relationships has essentially followed two paths: 1)species are ordinated based on PCA of average habitat values for individuals; 2) plots ordinated based on their average habitat values, and species' abundances on those plots correlated with the resulting component axes (which presumably reflect underlying environmental gradients). Our proposed synthetic method is plot-based, but requires that sample points within plots be classified as lying within or outside of each individual species' area of use. As in (2), the total environmental variation, or multidimensional "habitat space", is defined by PCA of plot habitat values. However, rather than subjecting habitat values for each species to an independent PCA as in (1), a simple methodology may be used to map each species in the habitat space described by the plot PCA. Several advantages accrue to mapping species and plots in the same environmental space. By graphing contours of species densities in this multidimensional space, patterns of abundance/habitat relationships that are not apparent from simple correlational analysis may emerge. Comparisons of plot means with values for individual species within a plot may reveal active habitat selection, or even consistent patterns of within-plot habitat partitioning between two species. Comparisons of density contours may suggest the presence of biological interactions, such as competition or ecological replacement, between two or more species. The use of this technique is illustrated by analysis of 22 structural habitat variables collected at 26 North American grassland and shrubsteppe sites.

544

Roth, R.R.;
Spatial heterogeneity and bird species diversity.
Ecology 57:773-782 1976

KEYWORDS: avian community;avian diversity;bird-habitat relationships;forest diversity;forest structure;habitat selection;Texas USA;Illinois USA

ABSTRACT: A heterogeneity index, D, derived from the point-quarter technique was significantly correlated with bird species diversity (BSD) for several shrub and forest areas. It predicted BSD for a series of similar brushlands where other indices had failed. Species richness increased faster than species overlap in a series of increasingly complex habitats up to the forest stage. Species overlap was negatively correlated with patchiness. Additional species may be accommodated in preforest habitats primarily by horizontal spatial segregation facilitated by the presence of additional patches. New patches result from the addition of layers of vegetation. In late shrub or forest stages other kinds of segregation such as vertical segregation become important to species packing. Patchiness, as measured here, has a proximate effect on avian diversity. The extent or existence of latitudinal gradients in habitat patchiness and the effect on bird species diversity is unknown. The need remains for a universal, simple, yet meaningful, heterogeneity index which incorporates both horizontal and vertical variability of vegetation.

545

Rov, N.;
Breeding bird community structure and species diversity along an ecological gradient in deciduous forest in western Norway.
Ornis. Scand. 6: 1-14. 1975

KEYWORDS: breeding birds;avian communities;avian diversity;ecological gradient;forest structure;forest diversity;passerines;deciduous forest;Norway

ABSTRACT: The passerine community was censured by territorial mapping at four different points along a forest gradient. For each community, species diversity was calculated by Shannon's formula, and dominance index by summing the relative abundance values of the two most abundant species. Diversity and dominance were negatively correlated. Foliage profiles in each plot were estimated, and diversity of stratification calculated by Shannon's formula. An index of vegetation cover was calculated as the sum of the cover values of the shrub and tree layers. Bird species diversity was positively correlated with both vegetation cover and diversity of stratification, whereas dominance index was negatively correlated with the same factors. The way of subdividing the vegetation which gave the best correlations was 1) all non-woody plants, 2) all woody plants < 3 m above ground-level, and 3) all woody plants > 3 m.

546

Rowe, J.S.; Scotter, G.W.
Fire in the boreal forest.
Quatern. Res. 3:444-464 1973

KEYWORDS: fire: effects of;boreal forest ecosystem;vegetation composition;soil properties;animal populations

ABSTRACT: The boreal forest in North America owes much of its floristic and faunistic diversity to periodic fires ignited by lightning and by men since he appeared on the scene. The indirect evidences of burning in vegetation and soils, and recent direct observations of fires, are reviewed. Fire is shown to exert a significant effect on vegetational composition, on soil chemical properties and thermal regime, and on animal populations through the particular mosaic of habitats created. In turn, fire is itself influenced by the nature of geographic landscape ecosystems according to their surface forms, accumulations of organic materials, and susceptibility to drought. It is concluded that fire should be viewed as a normal ecological process in the boreal forest. A thorough understanding of its long-term role in terrestrial and aquatic ecosystems is needed.

547

Runde, D.E.;
Trees used by primary cavity-nesting birds in a northern hardwood forest.
M.S. Thesis, Univ. Vermont, Burlington. 78 p. 1981

KEYWORDS:

ABSTRACT: not reviewed

548

Runde, D.E.; Capen, D.E.
Characteristics of northern hardwood trees used by cavity-nesting birds.
J. Widl. Manage. 51: 217-223. 1987

KEYWORDS: cavity-nesting birds;habitat selection;cavity-tree characteristics;breeding birds;snags;management implications;hardwood forest;Vermont USA

ABSTRACT: Characteristics of nest trees used by 4 species of cavity-nesting birds were investigated in a northern hardwood forest in Vermont. A total of 110 nests was found for the yellow-bellied sapsucker, hairy woodpecker, downy woodpecker, and black-capped chickadee. The 110 nest trees were compared to 440 selected non-nest trees to identify tree characteristics associated with the presence of active cavity nests. Criteria to identify potential cavity-nest trees were developed. Woodpecker and sapsucker nest were associated with live, deciduous trees with fruiting bodies of heartwood decay fungi, branch stubs, broken tops, or previously excavated cavities. Chickadees used well decayed, deciduous snags with broken tops.

549

Ruppert, K.;
Recent results in increasing the nesting density of birds useful in forestry.
Mitt. Biol. Zenznst. Berl. 75:41-45 1953

KEYWORDS:

ABSTRACT: not reviewed

550

Salt, G.W.;
An analysis of avifaunas in the Teton Mountains and Jackson Hole, Wyoming.
Condor 59:373-393 1957

KEYWORDS: avian ecology;avian diversity;avian density/biomass;bird-habitat relationships;foraging behavior;Wyoming USA

ABSTRACT: *Censuses by strip transect of bird populations in six vegetation types at Jackson Hole, Wyoming, have been made. The three coniferous vegetation types are lodgepole, lodgepole-spruce-fir, and spruce-fir. These three are regarded as a successional sequence. The three deciduous forest types are willow-sedge swamp, scrub-meadow, and flatland aspen. The avifauna of each community has been analyzed into categories on the basis of feeding habits. Standing crop biomasses (total weight of living material) for each category and avifauna have been calculated. A consuming biomass of an avifauna is defined as the sum of species consuming biomasses. These are calculated by multiplying number of individuals times the mean weight of the species to the 0.7 exponent. Grams of consuming biomass are regarded as equivalent in terms of food consumption regardless of size of species. Total consuming biomass is taken as an index to energy metabolism by an avifauna. The efficiency of a species in energy use is proportional to its size. As a product of this relationship, the efficiency of an avifauna is indicated by the proportion of its biomass made up of large birds. This value is measured by the ratio of consuming biomass to standing crop biomass. The smaller the value, the greater is the efficiency. In the coniferous forest avifaunas an increase has been found in standing crop biomass and in efficiency, as measured by the ratio of consuming biomass to standing crop biomass, as succession proceeds toward the climax. In the avifaunas of Jackson Hole those of the coniferous forest have a greater herbivore (primary consumer) biomass than they do carnivore (secondary and tertiary consumer) biomass. In the deciduous forest avifaunas the relationship is reversed. Willow-sedge swamp and scrub-meadow avifaunas of Jackson Hole are of about equal standing crop biomass, but that of the willow-sedge swamp is more diversified, having more species in more categories. The avifaunas of the aspen groves parallel in a magnified way, in their species composition and biomasses, differences in floristics of hillside aspen and flatland aspen groves. Hillside aspen groves, which have about half the number of species of plants present in flatland groves, also have a meager avifauna. The avifauna of the flatland groves is rich and varied and has a large standing crop biomass. It is suggested that avifaunal size and efficiency in energy metabolism may prove to reflect ecosystem functions accurately enough so that avifaunal characteristics may be used as indices of the metabolism and efficiency of the entire biotic community.

551

Salwasser, H.; Tappeiner, J.C. II
Innovative responses to conservation challenges.
Trans. North. Am. Wildl. and Nat. Resour. Conf. 49:405-499 1984

KEYWORDS: forestry-wildlife management;ecosystem approach;biological diversity;featured species;integration principles application

ABSTRACT: Recent shifts in how society values natural resources have led to an increased emphasis on multiple-resource management with an ecosystem perspective. This calls for integration of management plans and activities for intensive land management. A review of historic approaches to integration lead us to outline six principles of wildlife habitat integration with timber management: 1) use of Management Areas, 2) specification of wildlife Resource Goals, 3) development of Habitat Criteria for featured wildlife, 4) scheduling of activities over time and space, 5) preparation of stand management prescriptions, and 6) periodic monitoring and revision of plans. Application of the first four of these principles to an actual management area showed that timber and wildlife can be managed over the long-run for a sustained yield of both. By selecting wildlife species with a broad range of habitat needs for emphasis on the area management can feature certain species and provide the full spectrum of wildlife diversity. Our ability to achieve ecosystem management is currently limited by our understanding of the interactions of relatively few system components. As we enter this era of intensive multi-resource land management we must apply this understanding at the same time we work to expand our knowledge. Wildlife habitat relationships are the most significant new tool for applying wildlife knowledge to ecosystem management.

552

Samson, F.B.;
Island biogeography and the conservation of nongame birds.
Trans. N. Aver. Wildl. and Natur. Resour. Conf. 45:245-251 1980

KEYWORDS: island biogeography;equilibrium model;forest size;nongame birds;habitat alteration;management implications;conservation implications

ABSTRACT: First, habitat for nongame birds is becoming increasingly isolated by agricultural or other human activities, thus more insular in character. The number of species on these islands is influenced by area, distance between islands and rates of immigration and extinction. These factors should be considered in the conservation of nongame birds. The need is urgent because the process of habitat fragmentation is escalating and generally irreversible. Second, to date no study has shown that a nongame bird breeding in North America is restricted to small habitat islands while many are habitat size-dependent, requiring large contiguous habitats. Thus, I reiterate the suggestion of other authors that size of habitat be emphasized in the conservation of nongame birds. This does not exclude preservation of small, unique or diverse habitats needed for any taxa that survive in these areas. Third, that species centered approach may be the most useful for nongame bird management. In practice, the species-area concept may aid in the selection of the species, and the concept also has application in land use planning. The challenge now is to implement a widely accepted viable ecological theory in the management of nongame birds. Its usefulness in the management of game birds, big game and a host of other nongame taxa is already evident.

553

Sanders, C.J.;
Populations of breeding birds in the spruce-fir forests of northwestern Ontario.
Can. Field. Nat. 84:131-135 1970

KEYWORDS: breeding bird populations;bird-insect relationships;spruce budworm;budworm outbreak;immature stand;mature stand;spruce-fir forests;Ontario

ABSTRACT: Breeding populations of birds in the spruce-fir forests of northwestern Ontario during the current low population density of the eastern spruce budworm averaged 123 pairs/100 acres compared to 319 recorded by Kendeigh (1947) in the same area during a budworm outbreak. The difference may be attributed to the virtual absence of four species of Parulidae which are known to respond numerically to increases in budworm density.

554

Sanderson, H.R.Bull, E.L.; Edgerton, P.J.
Bird communities in mixed conifer forests of the interior northwest.
Pp. 224-246 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: avian succession;bird-habitat relationships;forest succession;forest management;even-aged management;uneven-aged management;intensive management;salvage/sanitation;treatment area: size/shape;mixed-conifer forest;management implications;USA

ABSTRACT: Forest management practices adjust the direction and pace of plant succession. The species composition and structure are altered, and, in turn, the avian species. Forest management must include wildlife as an integral part of the management decision. A wildlife biologist must provide sound biological alternatives for the land manager's consideration. We present a discussion of ecological concepts that wildlife biologists can use to predict the response of bird alterations on the interior Northwest mixed conifer type.

555

Savidge, J.A.;
Effects on wildlife of herbicide-induced habitat change, Tahoe National Forest, California.
M.S. Thesis. Univ. of California, Berkeley, 16 p. 1977

KEYWORDS:

ABSTRACT: not reviewed

556

Savidge, J.A.;
Wildlife in a herbicide-treated Jeffrey pine plantation in eastern California.
J. For. 76: 476-478. 1978

KEYWORDS: herbicides: effects of;breeding birds;bird-habitat relationships;habitat suitability;coniferous forest;California USA

ABSTRACT: In a plantation of Jeffrey pine, spraying with 2,4, 5- T thinned some brush species while encouraging others. The change in vegetation substantially reduced populations of resident birds, both in numbers of individuals and species. Mule deer likewise were reduced in number on the sprayed area. Conversely, some small mammals, particularly chipmunks, increased.

557

Schemnitz, S.D.;
Wildlife habitat and management in the boreal forests of northeastern United States and boreal Canada.
Paper presented at IUFRO, Wildlife Habitat Meeting, Subgroup 1.08, Budapest, Hungary. 1973

KEYWORDS: wildlife habitat;forest management;logging;silviculture;land-use planning;boreal forest

ABSTRACT: *To a large extent forest and wildlife management are compatible. One of the keys to an optimum wildlife habitat is the diversity. In the past nature provided this diversity, and variety of forest types through mortality caused by wind storms, catastrophic fires, or disease and insect infestations. Due to curtailment of natural losses by improved forest protection efforts, the forest manager must substitute improvement and harvest cuts to maintain essential forest diversity.

558

Schemnitz, S.D.;
The effects of forest management practices on wildlife in eastern United States.
Pp. 700-730 In: Proceedings of the XVI IUFRO Congress. 1976

KEYWORDS: wildlife: influence on;forest management;clearcutting;stand improvement;reforestation;chemical treatment;fire: prescribed;habitat suitability;bird-habitat relationships;USA

ABSTRACT: **A review of current forest management practices in eastern United States as they influence wildlife populations. Emphasis was placed on the role of timber harvest and intermediate silvicultural treatments (timber stand improvement). Other forest practices that were evaluated included stand conversion and type rehabilitation, artificial reforestation, forest openings, controlled burning, forest fertilization, forest range management, green tree reservoirs, and chemical application (herbicides, pesticides, chemical debarking). Response of non-game birds, raptors, forest grouse, and wild turkey and endangered woodpeckers to particular forest management practices were discussed. Mammalian species groups receiving detailed consideration were herbivores and bear, furbearers, and forest rodents.

559

Schoen, J.W.; Wallmo, O.C.;Kirchhoff, M.D.
Wildlife-forest relationships: is a re-evaluation of old-growth necessary?
Trans. North Am. Wildl and Nat. Resourc. Conf. 46:531-545 1981

KEYWORDS: wildlife-forest relationships;old-growth forest;forest structure;forest succession;timber harvest;silviculture;even-abed stand;uneven-aged stand

ABSTRACT: Old growth today is a limited and nonrenewable resource of great importance to some wildlife species and of unknown importance to many others. The opportunities to study wildlife/old-growth relationships will, for some species, be very difficult since old growth habitat, in many areas, is disappearing faster than we can adequate understanding of it. There is a pressing need to understand more completely the ecology of old growth in order to provide responsible wildlife-forest management.

560

Schroeder, R.L.;
Habitat suitability index models: yellow warbler
U.S. Dept. Int., Fish and Wildlife Services, Div. Ecol. Serv., Biol. Rept. 82(10.27). 8 pp. 1982

KEYWORDS: yellow warbler;habitat requirements;habitat suitability index;habitat evaluation;management implications

ABSTRACT: Habitat preferences of the yellow warbler are described in this publication. It is one of a series of Habitat Suitability Index (HSI) models and was developed through an analysis of available information on the species-habitat requirements of the species. Habitat use information is presented in a review of the literature, followed by the development of an HSI model, designed for use in impact assessment and habitat management activities.

561

Schroeder, R.L.;
Habitat suitability index models: black-capped chickadee.
US Depart. Int. Fish and Wildlife Service Div. of Biol. Serv., Biol. Rep. 82(10.37). 12 p 1983

KEYWORDS: black-capped chickadee;habitat requirements;habitat suitability index;habitat evaluation;management implications

ABSTRACT: A review and synthesis of existing information was used to develop a habitat model for the black-capped chickadee. The model is scaled to produce an index of habitat suitability between 0 (unsuitable habitat) and 1 (optimally suitable habitat) for areas of the continental United States. Habitat suitability indexes are designed for use with Habitat Evaluation Procedures previously developed by the U.S. Fish and Wildlife Service.

562

Schroeder, R.L.;
Habitat suitability index models: downy woodpecker.
US Depart. Int., Fish and Wildlife Service, Div. Biol. Serv., Biol. Rept. 82(10.38). 10 p. 1983

KEYWORDS: techniques: habitat suitability index;modeling;habitat requirements;downy woodpecker;management implications

ABSTRACT: A review and synthesis of existing information was used to develop a habitat model for the downy woodpecker. The model is scaled to produce an index of habitat suitability between 0 (unsuitable habitat) and 1 (optimally suitable habitat) for areas of the continental United States. Habitat suitability indexes are designed for use with Habitat Evaluation Procedures previously developed by the U.S. Fish and Wildlife Service.

563

Schroeder, R.L.;
Habitat suitability index models: pine warbler.
U.S. Dept. Int., Fish and Wildlife Service, Div. Ecol. Ser., Biol. Dept. 82(10.28). 8 p. 1982

KEYWORDS: pine warbler;habitat requirements;habitat suitability index;habitat evaluation;management implications

ABSTRACT: Habitat preferences of the pine warbler are described in this publication, which is one of a series of Habitat Suitability Index (HSI) models. Habitat use information is presented in a synthesis of the literature on the species-habitat requirements of the pine warbler, followed by the development of the HSI model. The model is presented in three formats: graphic, word, and mathematical, and is designed to provide information for use in impact assessment and habitat management activities.

564

Schultz, C.D. & Company, Ltd., ;
The environmental effects of timber harvesting operations in the Edson and Grand Prairie forests of Alberta. Vol. 1.
Project Report prepared for the Minister of Lands and Forests, Government of Alberta, Edmonton. 1973

KEYWORDS: timber harvest;environmental effects;vegetation alteration;wildlife;avian populations;coniferous forest;Alberta

ABSTRACT: *A report which considers the potential environmental impacts of timber harvest on vegetation, wildlife, and firs, as well as other impacts. Specifically for birds the report states: Apart from destruction of individual nesting sites, which are normally not common in any event in dense coniferous stands, the timber harvesting operations will have no apparent impact on bird populations. Upland game birds thrive on a mixture of cutovers and heavier cover. Waterfowl are not widely distributed, but their aquatic habitat will be unaffected by upland logging and road activity. No direct threat other than that of massive chemical spraying can be visualized. As with most other elements of the biotic environment, the prevention of large fires and their replacement with a mosaic of different cover types will benefit birdlife.

565

Schwab, F.E.;
Effect of vegetation structure on breeding bird communities in the dry zone Douglas fir forest of southeastern British Columbia.
M.Sc. Thesis, University of British Columbia. 117 pp. 1979

KEYWORDS: avian diversity;avian density;logging;fire: spring burn;post-fire responses;post-logging responses;seral stages;bird-habitat relationships;British Columbia

ABSTRACT: **The relationship between breeding birds and vegetation structure in the dry subzone of the interior Douglas-fir zone in the East Kootenay region of southeastern British Columbia is outlined in this thesis. The vegetation structure on the study area is altered by selective logging and spring burning. Avian species and densities were determined for successional and transition stages of vegetation. It was concluded that: bird species were non-randomly distributed in relation to successional stages; a unique community of birds is supported by most successional stages; and bird abundance was greater with greater successional age of a plot. Dense stands of young conifers and climax Douglas fir, however, had lower bird densities than the preceding successional stages.

566

Scott, V.E.;
Characteristics of ponderosa pine snags used by cavity-nesting birds in Arizona.
J. For. 76: 26-28. 1978

KEYWORDS: coniferous forest;snags;cavity-nesting birds;cavity-tree characteristics;snag management;habitat selection;management implications;Arizona USA

ABSTRACT: In the southwest, ponderosa pine snags are important as nest sites for cavity-nesting birds. A study in Arizona found that birds selected snags that were greater than 15 inches ind.b.h. and taller than 75 feet. Preferred snags had more than 40 percent bark cover and had been dead six or more years.

567

Scott, V.E.;
Bird response to snag removal in ponderosa pine.
J. Forest. 77: 26-28 1979

KEYWORDS: snags;cavity nesting birds;timber harvest;bird-habitat relationships;snag management;management implications;pine: ponderosa;Arizona USA

ABSTRACT: *In an Arizona study the population of cavity-nesting birds declined by 52 percent on a plot in ponderosa pine when conifer snags were removed during a timber harvest but some quaking aspen snags were left standing. On an adjacent plot where snags were left standing, birds increased by 23 percent. There was also a 31 percent increase on an unharvested control plot. Population of violet-green swallows decreased from 20.7 pairs per 100 acres to 2.2 pairs on the plot where the snags were removed. There was no significant change in populations of open-nesting birds but gray-headed juncos and American robins increased on all plots.

568

Scott, V.E.; Crouch, G.L.
Response of breeding-birds to commercial clearcutting of aspen in southwestern Colorado.
USDA For Serv., Rocky Mountain Forest and Range Exp. Stn., Research RM-475. 5 pp. 1987

KEYWORDS: avian diversity;avian density;bird-habitat relationships;clearcutting;blockcutting;management implications;aspen forest;Colorado USA

ABSTRACT: Breeding birds on an aspen forest in southwestern Colorado increased in species diversity after 25% of the timber sale area forest was clearcut in patches of 3 to 20 acres. Bird population density on the forest with the clearcuts was not significantly different from that on an uncut forest. Of the 20 species evaluated, six were more and one was less abundant than on the uncut forest.

569

Scott, V.E.; Crouch, G.L.
Breeding birds in uncut aspen and 6- to 10-year-old clearcuts in southwestern Colorado.
USDA For. Serv., Rocky Mount. For. and Range Exp. Stn., Res. Note RM-485. 5 pp. 1988

KEYWORDS: clearcutting;breeding birds;bird-habitat relationship;avian diversity;avian density;edge;management implications;aspen forest;Colorado USA

ABSTRACT: Numbers of breeding birds were estimated to various sizes and ages of clearcuts, for edge habitat created by the clearcuts, leave strips between clearcuts, and uncut aspen forest (controls). Total numbers of birds were not different among three size classes or five age classes of clearcuts. Totals were lower on clearcuts than on edges but not different from controls or leave strips.

570

Scott, V.E.; Crouch, G.L.
Summer birds and mammals of aspen-conifer forests in west-central Colorado.
USDA For. Serv. Rocky Mount. For. Exp. Stn. Res. Pap. RM-280. 6 pp. 1988

KEYWORDS: bird-habitat relationships;avian diversity;avian density;feeding guilds;management implications;mixed-wood forest;Colorado USA

ABSTRACT: The number of bird species observed in aspen was lower than in mixed aspen-conifer stands, but not markedly different from the number in the conifer stands. Total bird density was not different among stands; but several birds were more abundant in aspen, conifer, or mixed forests. The aspen-dominated stands, with fewer snags and smaller trees, probably reflect earlier successional stages than the other stands, but bird diversity and density were not different from the conifer stands, which represent the older successional stage. The greatest number of bird species was recorded in mixed stands.

571

Scott, V.E.; Crouch, G.L.
Breeding birds and small mammals in pole-sized lodgepole pine and small inclusions of aspen in central Colorado.
USDA For. Serv., Rocky Mount. For. and Range Exp. Stn., Research Note RM-482. 4 pp. 1988

KEYWORDS: avian diversity;avian density;bird-habitat relationship;forest diversity;habitat suitability;management implications;pine: lodgepole;aspen inclusions;Colorado USA

ABSTRACT: Numbers of birds and mammals in small aspen stands within a pole-sized lodgepole pine forest were compared with those found in the surrounding conifer forest. Some birds and one mammal that are usually associated with conifer forests were more abundant in the aspen than in the lodgepole pine. However, the aspen stand appear too small to provide habitat for aspen obligates.

572

Scott, V.E.; Crouch, G.L.;Whelan, J.A.
Responses of birds and small mammals to clearcutting in a subalpine forest in central Colorado.
USDA For. Serv., Rocky Mount. For. and Range Exp. Stn. Res. Note RM-422. 6 pp. 1982

KEYWORDS: clearcutting;block cutting;bird-habitat relationships;avian density;management implications;coniferous forest;Colorado USA

ABSTRACT: Total numbers of birds were not significantly changed after 36% of a 100 acre timber stand was harvested in 12, small clearcuts. A small, post harvest decline occurred in the "foliage nesting" and "picker and gleaner" feeding guilds. There was not significant change in small mammal populations after timber harvest.

573

Scott, V.E.; Evans, K.E.;Patton, D.R.;Stone, C.P.
Cavity-nesting birds of North American forests
USDA Agric. Handb. 511, 112 p 1977

KEYWORDS: cavity-nesting birds;habitat;nest sites;tree use;food;distribution;North America

ABSTRACT: "Some 85 species of North American birds excavated nesting holes, use cavities resulting from decay (natural cavities), or use holes created by other species in dead or deteriorating trees. Such trees, commonly called snags, have after been considered undesirable by forest and recreation managers because they are not aesthetically pleasing, conflict with other forest management practices, may harbor forest insect pests, or may be fire or safety hazards. In the past such dead trees were often eliminated from the forest during a timber harvest. As a result, in some areas few nesting sites were left for cavity-nesting birds. Current well-intentioned environmental pressures to emphasize harvesting large dead or dying trees, if realized, would have further adverse effects on such ecologically and aesthetically important species as woodpeckers, swallows, wrens, nuthatches, and owls - to name a few.

574

Scott, V.E.; Gottfried, G.J.
Bird response to timber harvest in a mixed conifer forest in Arizona.
Res. Pap. RM-245. Fort Collins CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station 8pp. 1983

KEYWORDS: timber harvest;block cutting;single tree selection;selection cutting;post-logging response;avian density;avian diversity;bird-habitat relationships;management implications;coniferous forest;Arizona USA

ABSTRACT: Timber harvesting in southwestern mixed conifer forests should not adversely affect bird density or species diversity, provided removals are less than 30% to 40% of the stand basal area. This study, at Thomas Creek in eastern Arizona, evaluated changes in a bird population before and after an operational timber harvest designed to benefit several resources. Bird population changes were also compared with an uncut stand. The silvicultural prescription for the virgin, uneven-aged forest called for group selection on southfacing slopes and for individual tree selection with patch clearcutting on the north-facing slopes. Patches were from 0.5 to 3.0 acres. The harvest removed from 24% to 34% of the total stand basal area, and from 28% to 37% of the overstory basal area. Sixty-eight acres were in patchcuts and in openings created by the group selection. A net volume of 3.4 million board feet was harvested. The harvest resulted in only minor changes in bird populations. Bird numbers decreased slightly (12%) but the number of species increased from 28 to 35. House wrens, American robins, and pine siskins were new additions to the area's bird population. There were no significant differences in bird numbers when analyzed by nesting and feeding guilds. The ruby-crowned kinglet was the only major species to show a significant decrease.

575

Scott, V.E.; Oldemeyer, J.L.
Cavity-nesting bird requirements and responses to snag cutting in ponderosa pine.
Pp. 19-23 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: cavity-nesting birds;avian density;timber harvest;cutovers;snags;management implications;Arizona USA

ABSTRACT: Cavity-nesting bird densities declined 53% when conifer snags were removed during a timber harvest on the Apache-Sitgreaves National Forest in Arizona. On an adjacent cutover area where snags were left standing the cavity- nesting bird population increased 25%. Cavity-nesting bird densities on an unharvested control plot increased 32%. Birds that nested in ponderosa pone snags were affected most by snag removal.

576

Scott, V.E.; Whelan, J.A.;Alexander, R.R.
Dead trees used by cavity-nesting birds on the Fraser Experimental Forest: a case history.
USDA For. Serv., Rocky Mount. For. and Range Exp. Stn., Res. Note RM-360. 4pp. 1978

KEYWORDS: snags;cavity-nesting birds;cavity-tree characteristics;snag management;management implications;coniferous forest;Colorado USA

ABSTRACT: A total of 1,722 lodgepole pine, subalpine fir and Engelmann spruce snags were surveyed for cavity-nesting bird use on the Fraser Experimental Forest in Colorado. Broken-top snags greater than 12 inches dbh had the highest percentage of bird use. Holes were also found in live trees with broken tops and scars. It is recommended that all broken-top snags greater than 8 inches dbh be left standing for snag dependent wildlife and that live trees with broken tops or scars be left standing during timber harvest to insure future sites for cavity-nesting birds.

577

Scott, V.E.; Whelan, J.A.;Svoboda, P.L.
Cavity-nesting birds and forest management.
Pp. 311-324 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: cavity-nesting birds;avian diversity;cavity tree characteristics;snags;bird-habitat relationships;management implications;pine: ponderosa;aspen: subalpine;Colorado USA

ABSTRACT: The characteristics of snags used by cavity-nesting birds were examined in 3 timber types (aspen, ponderosa pine, and the subalpine zone). The number of snags with holes varied from less than 10 per 10 acres in the subalpine zone on the Fraser Experimental Forest in Colorado to 26 per 10 acres in ponderosa pine in Arizona. Size and species of snags used by cavity-nesting birds were examined and are discussed. Some management problems and suggestions are also discussed.

578

Scotter, G.W.;
Fire as an ecological factor in boreal forest ecosystems of Canada.
In. N. Amer. Forestry Commission. 1972

KEYWORDS: boreal forest;fire: effects of;ecological factor;Canada

ABSTRACT: *Fire is one of the important factors influencing the vegetative cover of the boreal forest region of Canada. It is partly responsible for maintaining extensive stands of jack pine, lodgepole pine, black spruce, trembling aspen, and white birch. Natural selection within these tree species has favored development of fire survival characteristics that ensure maintenance of the species. The boreal forest has been subject to extensive and repeated fires during prehistoric and historic times. Lightning is the principal cause of fire in the north but man is also an important agent. The net effect of fire on the ecosystem is complex and highly variable depending on site, frequency of fire, severity of fire, and a host of other factors. However, fire may serve a vital role in ecosystem functioning through periodic energy conversion. Such energy conversion, combined with the selected adaptations of plants to regenerate after fire, may add to the stability and viability of boreal forest ecosystems. Soil properties, at least with infrequent fires, do not appear to be influenced to the detriment of future plant communities. The influence of fire on animals in the boreal forest region cannot be easily evaluated. Certain members of the animal community are beneficially affected and others are at a disadvantage, at least over the short-term.

579

Scoullar, K.A.;
Using land resource maps to define habitat for forest birds.
M.Sc. Thesis, University of British Columbia, Vancouver, B.C. 295 pp. 1980

KEYWORDS: forest birds;bird-habitat relationships;nesting requirements;forest succession;post-logging responses;avian densities;foraging behaviour;land resource maps;management implications;British Columbia

ABSTRACT: **A thesis which describes habitat associations of number of avian species in relation to forest structure of several seral stages. Requirements for feeding and nesting are discussed. Most species examined preferred older seral stages, and of those species related to vegetation type, only one species did not show a preference for vegetation associated with high soil moisture. Management for species which use medium-age seral stages, though preferring mature and old growth, include preserving mature and old growth stands and extending rotation length. The only way to preserve species which are excluded from timber management areas is to preserve the mature and old growth forest they require as habitat.

580

Sedgewick, J.A.; Knopf, F.L.
Cavity-nesting birds and the cavity-tree resource in plains cottonwood bottomlands.
J. Wildl. Manage. 50:247-252 1986

KEYWORDS: cavity-nesting birds;snags;avian density;cavity-tree characteristics;habitat selection;breeding birds;management implications;deciduous forest;Colorado USA

ABSTRACT: Densities of, and potential nesting substrates for cavity-nesting birds were examined in a mature plains cottonwood community in northeastern Colorado. Although snag (dead tree) densities were low (0.66 ha), the cavity-nesting guild included 7 species with densities <=463 birds/100 ha. This finding suggests that cavity nesters are not limited by snag densities. Most (94.2%) of the nest substrate for cavity-nesting birds was provided by live trees with large, dead limbs (>= 10 cm in diam). Both total dead limb length and the number of trees with dead limbs were highly correlated (P<0.001) with the number of cavities excavated. Large trees (>55 cm in diam. at breast height [dbh]) and dead limbs 15-30 cm in diameter were preferred for cavity excavation. Because snags were a minor component of potential nest substrate, snag management may not be a useful concept for cavity-nesting birds in cottonwood bottomlands, and snag retention aspects of habitat models would be relatively unimportant for this forest type. Live-tree management is recommended.

581

Serrao, J.;
Decline of forest songbirds.
Records of New Jersey Birds. 11:5-9 1985

KEYWORDS:

ABSTRACT: not reviewed

582

Servos, M.C.;
Summer habitat use by great gray owls in southeastern Manitoba.
Pp. 108-114 In: R.W. Nero, R.J. Clark, R.J. Knapton, and R.H. Hamre, eds. Biology and conservation of northern forest owls symposium proceedings. USDA For. Serv. Gen. Tech. Rept. RM-142 1987

KEYWORDS: great gray owls;habitat selection;movement;prey abundance;management implications;Manitoba

ABSTRACT: Sixteen radio-marked great gray owls, were monitored from 27 June to 28 August 1984 to determine summer habitat use in southeastern Manitoba. Owls showed a strong preference for tamarack bogs, but other wet, open areas with adequate perches, such as treed muskeg habitats were also selected. Factors influencing habitat selection include availability of prey species (meadow voles and bog lemmings), suitable perches, cover, and shrub density.

583

Seymour, R.S.;
Trends in forest management: potential effects of "Good Forestry" on future habitat.
Pp. 239-250 in: J.A. Bissonette, ed. Is good forestry good wildlife management? Proc. of a Joint Conference, March 6-8, 1985, Portland, Maine. 1986

KEYWORDS: forest management;economics;sustainable yield;forest structure;site conversion;wildlife habitat;management implications

ABSTRACT: "Good" timber management practices provide a sustained yield of forest products, make efficient use of machinery and manpower, fully utilize the site, and maximize economic returns for the forest landowner. Achieving these goals, through widespread implementation of intensive timber management, could significantly alter future forest structure and wildlife habitat in New England. Compared to the present conditions, forest managed intensively for timber may have greater overall diversity in age, but will probably be less variable in species composition and small-scale spatial diversity. Old-growth overmature stands, and natural hardwood stands on highly productive sites, are existing habitat types likely to become scarce, and merit special attention by wildlife managers.

584

Shaffer, M.L.;
The metapopulation and species conservation: The special case of the northern spotted owl.
Pp. 86-99. in: R.J. Gutierrez and A.B. Carey, Tech. eds. Ecology and management of the spotted owl in the Pacific Northwest. USDA For. Serv. Gen. Tech. Rept. PNW-185 1985

KEYWORDS: northern spotted owl;metapopulation model;forest size/density;land-use planning;wildlife management;conservation implications

ABSTRACT: The conservation of patchily distributed species presents a complex problem for land-use planning and wildlife management. A new paradigm of population structure will be necessary to understand the extinction-persistence dynamics of such species both for site-specific and regional conservation efforts. The metapopulation model provides a beginning conceptual framework for solving this problem. The model is reviewed in light of the problem of avoiding stochastic extinctions and illustrated with the current problem of conserving the northern spotted owl in the Pacific Northwest. Major theoretical and empirical research needs are identified both for the applicability of the metapopulation model in general and for the northern spotted owl in particular.

585

Sheffield, R.M.;
Multiresource inventories: techniques for evaluating nongame bird habitat.
USDA For. Serv.. Southeas. Exp. St., Res. Pap. SE-218. 28 pp. 1981

KEYWORDS: nongame bird habitat;habitat evaluation;habitat parameters;multiresource inventories;management implications

ABSTRACT: Procedures for evaluating the suitability of forest lands for the breeding habitat of individual nongame bird species and entire avian communities are presented. A multiresource inventory of South Carolina's forest resources, conducted by Renewable Resources Evaluation provides the necessary habitat data. Nine nongame species, representative of a broad range of habitat types, are selected as examples of evaluation. Habitat descriptions for these species were obtained from the literature and the screening criteria were formulated. The resulting estimates of habitat extent, condition, and distribution are presented.

586

Shilova-Krassova, S.A.;
On the activity of insectivorous birds in a place of mass outbreak of harmful forest insects.
Zool. Zhur. 32:955-963 1953

KEYWORDS:

ABSTRACT: not translated

587

Shook, R.S.; Baldwin, P.H.
Woodpecker predation on bark beetles in Engelmann spruce logs as related to stand density.
Can. Entom. 102: 1345-1354. 1970

KEYWORDS: spruce beetles;spruce beetle outbreaks;forest structure;foraging behaviour;coniferous forest;Colorado USA

ABSTRACT: Eighty Engelmann spruce logs, which were distributed in open, semi-open, and dense spruce forest, were infested with Dendroctonus obesus (Mann.) and Ips pilifrons Sw. and fed upon by northern three-toed and hairy woodpeckers. Sections of the infested boles were covered with screen to prevent woodpeckers feeding and

all logs were left in the field over one winter and through the following summer. By spring, the spruce beetle brood was reduced by approximately 50% in all three forest areas. By fall the spruce beetle brood suffered a 71, 83, and 52% reduction in the open, semi-open and dense forest, respectively. Spruce beetles appeared to be in greatest in the semi-open forest, resulting in the greatest woodpecker predation there. Woodpeckers did not feed in the open meadows. Estimates in the spring, before the Ips emerged from the logs, showed that woodpeckers reduced the Ips brood by 76 and 11% in the open and semi-open forest, respectively. Ips were not found in dense forest or meadows.

588

Shugart, H.H.; Crow, T.R.;Hett, J.M.
Forest succession models: A rationale and methodology for modelling forest succession over large regions.
Forest Science 19: 203-212. 1973

KEYWORDS: forest succession;techniques: model;forest diversity;Michigan USA

ABSTRACT: The modelling methodology includes recognition of cover-states which are similar to successional stages. The general form of the model is ordinary linear differential equations using considerations of stand dynamics and silvics to determine rates of change. Output from an example model for 250 years of succession on the western Great Lakes region in the absence of forest fires, epidemics, and management is presented and discussed. Changes are indicated. The conditions under which the model should simulate succession are stated explicitly.

589

Shugart, H.H.; Anderson, S.H.;Strand, R.H.
Dominant patterns in bird populations of the eastern deciduous forest biome.
Pp. 90-95 in: D.R. Smith, tech. coord. Proc. of the symposium on management of forest and range habitats for nongame birds. USDA For. Serv. Gen. Tech. Rept. WO-1. 1975

KEYWORDS: avian ecology;breeding bird populations;avian density;avian diversity;avian energetics;bird-habitat relationships;management implications;deciduous forest;discriminant function analysis

ABSTRACT: There are several general patterns of variation evident in bird populations of the eastern deciduous forest biome. The avifauna of the eastern forests is typically dominated by migrants and there is a pronounced increase in the bird standing crop during the breeding season. The importance of birds as components of ecosystem stems from their mobility and from their high trophic position on many food webs. During secondary succession, bird populations typically increase in density, diversity, and standing crop with time. The energies of bird populations in forests are strongly correlated with the densities of the population. Habitat selection is an important determining factor for bird distributions and habitat factors are generally more important than food-availability factors in avian resource division. Discriminant function analysis is demonstrated as a potential research tool for determining bird habitat preferences.

590

Shugart, H.H.; Dueser, R.D.;Anderson, S.H.
Influence of habitat alterations on bird and small mammal populations.
Pp. 92-96 In Timber-wildlife management symp. Missouri Acad. Sci Occas. Pap. 3. 1974

KEYWORDS: habitat assessment;bird-habitat relationships;habitat alterations;habitat selection;forest structure;breeding birds;principal component analysis;hardwood forest;Tennessee USA

ABSTRACT: Recent studies of bird and small mammal populations at Oak Ridge National Laboratory have focused on determining what habitat variables are strongly associated with the presence or absence of a species. Results from these studies provide insight into what species will be favorably or adversely affected by certain types of habitat alteration. Alternatively, the results can also be used to determine what sort of habitat alterations might increase the amount of habitat associated with a species. Multi-variate statistical analysis techniques are used to take into account the known intercorrelations among habitat variables. The data

collection techniques are designed to provide a list of options of expected effects on bird and mammal populations to a landscape manager.

591

Shugart, H.H.; James, D.
Ecological succession of breeding bird populations in northwestern Arkansas.
Auk 90:62-77 1973

KEYWORDS: forest succession;deciduous forest;breeding birds;avian ecology;avian density;avian diversity;bird-habitat relationships;avian succession;Arkansas USA

ABSTRACT: *Breeding bird populations in ten stages of the upland subsere succession were studied at Pea Ridge National Military Park, Benton County, Arkansas, during spring 1967. Bird populations were determined by the Williams' territory mapping technique. The habitats of the birds could be classified as field, intermediate, and forest. Certain species of forest birds were confined to the climax forest habitat. The density of bird populations increased with ecological age of the plots. The similarities in flora and avifauna on different plots were correlated significantly. The species diversity of birds increased with ecological age of the plots. Comparison with a similar study in Georgia indicated that species diversity in field habitats was relatively high in Arkansas. The presence of prairie adjoining forest in northwestern Arkansas may have allowed forest edge birds to become conditioned to grasslands so that they are now able to utilize grassier successional stages.

592

Shugart, H.H.; Smith, T.M.;Kitchings, J.T.;Kroodsma, R.L.
The relationship of nongame birds to southern forest types and successional stages.
Pp. 5-16 in: R.M. DeGraaf, tech. coord. Proc. of the Workshop: management of southern forests for nongame birds. Jan 24-26, 1978, Atlanta, Georgia. 1978

KEYWORDS: avian ecology;nongame birds;avian diversity;avian succession;forest succession;bird-habitat relationships;forest management;management implications;USA

ABSTRACT: This paper identifies general patterns of southern nongame bird species at three different spatial scales - the region, the forest stand, the microhabitat. Three hypothetical examples of nongame bird management are developed. Each example uses available information on nongame bird habitat requirements and tools used by forest managers. Possible future approaches to nongame bird management in the South are discussed.

593

Shugart, H.H.; West, D.C.
Forest succession models.
Bioscience 30:308-313 1980

KEYWORDS: techniques: modelling;forest succession;model applications;management implications

ABSTRACT: *In this paper we will review the models developed in forestry and ecology, with an emphasis on models of ecological succession.

594

Siderits, K.; Radtke, R.E.
Enhancing forest wildlife habitat through diversity.
Trans. N. Amer. Wildl. and Nat. Res. Conf. 42: 425-434. 1977

KEYWORDS: forest diversity;forest management;forest structure;avian communities

ABSTRACT: *Habitat diversity for species richness is a basic concept of wildlife management in the eastern region. This does not preclude specific habitat management to meet the requirement of specific species, such as those classified as endangered or threatened. Habitat conditions vary widely throughout the east so no uniform guides can be developed. Habitat guides can be developed, based on an ecosystem approach, to achieve a forest environment containing a variety of plant communities. A forest with an interspersion of different vegetative species, ages, and habitats can be best achieved through forest management. However, these advantages can be fully realized only if a high degree of management coordination exists between timber and wildlife. Timber management practices, if correctly planned and executed, are the most practical broad-scale forest habitat alteration tools that habitat managers may use to achieve wildlife goals. This forest diversity approach to wildlife management on the national forests of the eastern region has aided the forester in including habitat considerations in timber management programs and has helped to identify and include nongame wildlife habitat management in forest management programs.

595

Silovsky, G.D.; Pinto, C.
Forest wildlife inventories: identification of conflicts and management needs.
Pp. 53-61 in: H.C. Black, ed. Wildlife and forest management in the Pacific Northwest, Proceedings. Oregon State Univ., School of Forestry, Corvallis, Oregon. 1974

KEYWORDS: bird-habitat relationships;intensive timber management;clearcutting;silviculture;post-logging responses;indicator species;Oregon USA

ABSTRACT: **Changes occurring in a natural forest ecosystem as a result of intensive timber management were identified. Predictions were made on what the intensively managed forest would be like in 30 years and which species would or would not have its habitat requirements met in the future. Those avian species which would not be adversely affected and those that would be are listed. Populations of birds which depend on deciduous stands may be reduced in the future forest.

596

Slagsvold, T.;
Bird population changes after clearance of deciduous scrub.
Biol. Conserv. 12:229-244. 1977

KEYWORDS: habitat alteration;clearcutting;bird-habitat relationships;herbicides: effects of;forest succession;avian density;avian diversity;Norway

ABSTRACT: Clearance of deciduous scrub by cutting in Valdres, South Norway, or by spraying with 2,4,5-T, was followed by a 30% reduction in the number of bird territories in the following spring. The recorded changes were related to differing preferences of the bird species for successional stages of vegetation, i.e. the pioneer species increased while those which prefer old forest were heavily reduced. Four years later the bird population as a whole had increased in the cut area, but not in the invertebrate fauna and the vegetation of the habitat. A total of 314 single surveys (1970-1973 and 1976) were made in five census plots which covered a total area of 113 ha comprising both clearings and old spruce forest. The analysis is based on counts of singing males and estimates of territories held.

597

Sloan, N.F.; Coppel, H.C.
Ecological implications of bird populations on the larch casebearer in Wisconsin.
J. Econ. Entomol 61:1067-1070 1968

KEYWORDS: avian predators;larch casebearer;ecological implications;Wisconsin USA

ABSTRACT: *birds are important predators of larch casebearers in Winsconsin. Population decline of the casebearer in the winter, probably attributable to birds, was 23.5%. Spring predation by birds, between April and June, causes a significant loss in prey population, although many of the larvae eaten were parasitized. Feeding activities in the spring was 3 times that recorded in the fall.

598

Slusher, J.P. and Hinckley, T.M., eds., ;
Timber-wildlife management symposium proceedings.
Missouri Academy of Science, Occasional Paper 3., 131 pp. 1974

KEYWORDS: timber-wildlife management;symposium;multi-disciplinary planning;management implications

ABSTRACT: *This symposium sas designed to bring together nationally recognized authorities to discuss common opportunities, problems, goals and cooperative programs relating to wildlife and forest management. The program was held in Columbia, Missouri from January 22nd through the 24th, 1974, involving two hundred and eighty-eight participants from thirty-six states.

599

Small, M.F.; Johnson, W.N. Jr.
Wildlife management in riparian habitats.
Pp. 69-80 in: J.A. Bissonette, ed. Is good forestry good wildlife management? Proc. of a Joint Conference, March 6-8, 1985, Portland, Maine. 1986

KEYWORDS: riparian habitats;wildlife;timber management;buffer strips;travel corridors;nesting sites;group selection;management implications

ABSTRACT: Riparian habitats attract more diverse wildlife than do upland habitats because of the presence of water, the diversity of plant species, and the great number of edges. Wildlife use these areas for deer yards, travel corridors, and nesting sites. Timber harvesting practices that will benefit many wildlife species include the retention of a 75-m-wide buffer strip beside large streams, rivers, and lakes. A 25-m-wide zone adjacent to the water would be left undisturbed. All harvesting would be by group selection and would occur in the remaining 50 m. In certain instances, buffer strips may not be adequate for protecting a special feature associated with a riparian area.

600

Smith, D.R., tech. coord.;
Proceedings symposium: management of forest and range habitat for nongame birds.
USDA For. Serv., Gen. Tech. Rep. WO-1. 343 p. 1975

KEYWORDS: nongame birds;bird-habitat relationships;avian ecology;habitat management

ABSTRACT: *Nongame birds are a neglected ecological and recreational resource. Managers have known that birds eat insects and seeds and that some people like to watch them. But generally nongame birds have not been seriously considered in decisions on land management. Scientists, on the other hand, have long studied birds as an occupation or avocation, but they have seldom related their studies to land management activities. The recent increase in environmental awareness and dramatic changes in patterns of wildlife-related recreation are indicators that this Symposium was long overdue. Through it we have attempted to initiate a dialogue between resource managers and avian ecologists.

601

Smith, G.J.;
Pesticide use and toxicology in relation to wildlife: organophosphorus and carbamate compounds.
US Dept. Int., Fish and Wildl. Serv., Resource Publication 170. 171 p. 1987

KEYWORDS: pesticides;wildlife;toxicity;organophosphorus;carbamate

ABSTRACT: *This handbook summarizes available information on organophosphorus and carbamate pesticides in the wildlife toxicity literature and relates those data to potential hazards to wildlife by examining toxicity, environmental persistence, and use patterns of the pesticides included.

602

Smith, K.G.;
Nongame birds of the Rocky Mountain spruce-fir forests and their management.
Pp. 258-279 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: avian ecology;avian diversity;avian density;migratory status;life forms;foraging behaviour;forest management;fire control;cutting;rotation period;chemical control;management implications;spruce-fir forest;USA

ABSTRACT: Spruce-fir forests in the Rocky Mountains consist of mainly Engelmann spruce and subalpine fir. The breeding avifauna in these forests show remarkable consistency in composition along a latitudinal gradient from Montana to Arizona and New Mexico, and with avian communities in the Hudsonian life zone in Washington, Oregon and California. Woodpeckers, corvids, and seed-eating finches are the most common components. Only the Golden Eagle and a few other raptors are threatened or endangered. Few species winter in these high mountain forests. The distribution of many species is controlled by the vegetation physiognomy, a variable under the control of the forest manager. Fire control and snag management will generally benefit the avifauna, whereas most forest harvesting practices adversely affect, to differing degrees, the bird communities. It is suggested that the "life form" approach to avian communities may be easily implemented in these forests. It is recommended that high elevation spruce-fir forests be minimally harvested and used as reservoirs for spruce-fir birds. Lower elevational stands should be managed for harvesting and bird diversity, with special attention given to relic stands.

603

Smith, T.M.; Shugart, H.H.;West, D.C.
Use of forest simulation models to integrate timber harvest and nongame bird management.
Unpubl. Manuscript Oak Ridge Nat. Lab., Environ. Sci. Div., P.O. Box X, Oak Ridge, Tennessee. 21 pp.

KEYWORDS: modelling;forest structure;forest management;habitat alteration;bird-habitat relationships;cavity-nesting birds

ABSTRACT: Available animal habitat through time can be determined through the use forest simulation models which predict vegetational structure and composition. This process depends on a) the structural classification of forest stands in terms of suitability to provide habitat for a given animal species, and b) a forest simulator with the ability to generate the specific structural variables on which the classification is based. By introducing disturbances (e.g. fire, timber harvest) to the model, we can evaluate the effects of perturbations on the availability of habitat for a specific species. Examples are given of two forest simulation models used to predict available habitat for their corresponding avian communities. FORLOB (a loblolly pine stand simulator) was used to simulate loblolly pine stands in Arkansas to assess the effects of various forest management strategies on both timber production and the availability of habitat for the red-cockaded woodpecker. A second model. RORHAB (a deciduous forest succession model), was used to predict changes in the structure of the avian community on the Walker Branch Watershed in east Tennessee resulting from simulated timber management practices.

604

Smith, T.M.; Shugart, H.H.;West, D.C.
FORHAB: A forest simulation model to predict habitat structure for nongame bird species.
Pp. 114-123 in: D.E. Capen, ed. The Use of Multivariate Statistics in Studies of Wildlife Habitat. USDA For. Serv. Gen. Tech. Rep. RM-87. 1981

KEYWORDS: techniques;model;forest simulation;avian habitat;habitat structure;discriminant function analysis;linear decision scales;management implications

ABSTRACT: FORHAB (a deciduous forest stand simulation model) was used to predict changes in available breeding habitat for the avian community inhabiting the Walker Branch Watershed in east Tennessee. A census was conducted to locate all breeding territories of the various bird species on the watershed. Data on vegetational structure of these territories were used to calculate linear decision scales, a classification procedure based on discriminant function analysis, which could be used to classify forest stands as potential breeding habitat for the various bird species. FORHAB was used to simulate changes in forest structure of the watershed due to both natural succession and certain introduced forest management practices (diameter-limit cut). Variables describing the vegetational structure of the forest stands generated by FORHAB were used to determine availability of potential breeding habitat for each bird species through time using a subroutine based on the above-mentioned classification procedure. Predictions of available habitat for the ovenbird on the Walker Branch Watershed are presented as an example of model output.

605

Snyder, D.P.;
Bird communities in the coniferous forest biome.
Condor 52:17-27 1950

KEYWORDS: avian community organization;migratory status;biogeography;avian diversity;avian density;coniferous forest biome;Colorado USA

ABSTRACT: *Censuses of breeding birds were carried out in three plant communities in the Rocky Mountains of Colorado. The populations per 100 acres (40 ha) were 102 + pairs in Douglas fir and ponderosa pine, 94+ pairs in Engelmann spruce and subalpine fir, and 59+ pairs in lodgepole pine. The most abundant species were the Mountain Chickadee, Ruby-crowned Kinglet, Hermit Thrush, Pine Siskin, and Gray-headed Junco, and all except the kinglet occurred in each of the three communities. In the Rocky Mountains, an increase in elevation is correlated with an increase in birds of Old World origin and a decrease in birds of North American origin. This correlation is apparently brought about, in part, by the increase in the percentage of coniferous forest and the decrease in the percentage of deciduous forest in the vegetation at higher elevations. In the climax coniferous forest community in the Rocky Mountains most of the breeding pairs are of species of Old World origin and are in large part permanent residents. In the east the North American element is in the majority, and the birds are largely migratory. The distribution, zoogeographic origin, and migratory status of the breeding populations indicate that at least two distinct climax avian communities occur in the coniferous forest biome of North America. The Rocky Mountain community is named the Parus-Spinus coniferous forest biociation after the Mountain Chickadee and the Pine Siskin to distinguish it from the Dendroica-Regulus coniferous forest biociation of eastern North America.

606

Sousa, P.J.;
Habitat suitability index models: Veery.
U.S. Dept. Int., Fish and Wildlife Service, Div. Biol. Serv., Biol. Rept. 82(10.22). 12 pp. 1982

KEYWORDS: Veery;habitat requirements;habitat suitability index;habitat evaluation;management implications.

ABSTRACT: Habitat preferences and species characteristics of the veery are described in this publication. It is one of a series of Habitat Suitability Index (HSI) models and was developed through an analysis of available scientific data on the habitat requirements of the veery. Habitat use information is presented in a review of the literature, followed by the development of an HSI model. The model is presented in three formats: graphic; word; and mathematical. Suitability index graphs quantify the species-habitat relationship. These data are synthesized into a model designed to provide information for use in impact assessment and habitat management.

607

Sousa, P.J.;
Habitat Suitability Index Models: Williamson's sapsucker
U.S. Depart. of Int., Fish and Wildlife Service, Div. Biol. Serv., Biol. Rept. 82(10.47). 13 p 1983

KEYWORDS: Williamson's sapsucker;habitat requirements;habitat suitability index;habitat evaluation;management implications

ABSTRACT: A review and synthesis of existing information was used to develop a habitat suitability model for Williamson's sapsucker. The model is scaled to produce an index of habitat suitability between 0 (unsuitable habitat) and 1 (optimally suitable habitat) for the Williamson's sapsucker breeding range in North America. Habitat suitability indices(HSI's) are designed for use with Habitat Evaluation Procedures previously developed by the U.S. Fish and Wildlife Service.

608

Sousa, P.J.;
Habitat suitability index models: Lewis' woodpecker.
US Dept. Int., Fish and Wildl. Serv., Div. Biol. Werv., Biol. Dept. 82(10.32). 14 p. 1983

KEYWORDS: Lewis' woodpecker;habitat requirements;habitat suitability index;habitat evaluation;management implications

ABSTRACT: Habitat preferences of Lewis' woodpecker are described in this publication, which is one of a series of Habitat Suitability Index (HSI) models. A review and synthesis of the literature is followed by development of a model of the species-habitat requirements of Lewis' woodpecker. Habitat suitability indexes are designed for use with Habitat Evaluation Procedures previously developed by the U.S. Fish and Wildlife Service.

609

Sousa, P.J.;
Habitat suitability index models: hairy woodpecker.
U.S. Dept. Int., Fish and Wildlife Service, DN. Biol. Serv., Biol. Rept. 82(10.146). 19 p 1987

KEYWORDS: Hairy woodpecker;habitat requirements;habitat suitability index;habitat evaluation;management implications

ABSTRACT: A review and synthesis of existing information were used to develop a Habitat Suitability Index (HSI) model for the hairy woodpecker. The model consolidates habitat use information into a framework appropriate for field application, and is scaled to produce an index between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). HSI models are designed to be used with Habitat Evaluation Procedures previously developed by the U.S. Fish and Wildlife Service.

610

Spires, S.; Bendell, J.F.
Early postfire effects on some invertebrates, small mammals and birds in north-central Ontario.
Pp. 308-318 in: R.W. Wein, R.R. Riewe and I.R. Methven, eds. Resources and dynamics of the boreal zone. Proceedings of a conference held at Thunder Bay, Ontario, August, 1982. 1982

KEYWORDS: fire;avian ecology;post-fire response;avian diversity;avian density;foraging behavior

ABSTRACT: Animals were trapped or observed in burned and adjacent unburned forest during the first five weeks following an intense 380 ha ground and canopy fire in May 1981. The following general trends were found. Herbivores (e.g., Gapper's red-backed vole, snowshoe hare) were captured or observed in lower numbers in burned than in unburned forest. Granivores such as the deer mouse and white-throated sparrow were captured or observed in high numbers in both forests. Aerial insectivores (e.g., common nighthawk), ground insectivores (e.g., American robin, a tiger beetle) and hole insectivores (woodpeckers) were captured or observed in higher numbers in burned than in unburned forest. Foliage insectivores (mainly wood warblers) were observed in lower numbers in burned than in unburned forest. There were some exceptions to the above trends, for example the ground insectivorous masked shrew was captured in lower numbers in burned than in unburned forest. These exceptions may relate to requirements of the species involved for cover or moisture.

611

Sprunt, A. IV;
Habitat management implications of migration.
Pp. 81-86 in: D.R. Smith, tech. coord. Proceedings of the symposium on management of forest and range habitat for nongame birds. USDA For. Serv. Tech. Rep. WO-1. 1975

KEYWORDS: migratory birds;staging areas;habitat management;habitat diversity;management implications

ABSTRACT: Birds utilize most available habitats during their migrations. Some habitat types are more important than others while the location of still others makes them vital. Diversity is a key to good migrant habitat and should be considered in management planning.

612

Stanton, F.;
Fire impacts on wildlife and habitat.
U.S. Dept. Interior, Bur. Land Manage., Washington, DC. 48 p. 1975

KEYWORDS:

ABSTRACT: not reviewed

613

Stauffer, D.F.; Best, L.B.
Habitat selection by birds of riparian communities: evaluation effects of habitat alterations.
J. Wildl. Manage. 44:1-15 1980

KEYWORDS: habitat alteration;breeding birds;habitat selection;bird-habitat relationships;nesting-site selection;avian diversity;tolerance indices;riparian forest;Iowa USA

ABSTRACT: Avifauna of riparian communities were studied in Iowa during late spring and early summer. Birds were censused on 28 study plots representing a habitat gradient from hayfields to closed-canopy woodlands. An index of nesting niche breadth was determined for 18 open-nesting bird species on the basis of vegetation life form(s) used for nesting, and for 10 cavity-nesting species on the basis of type(s) of nest-cavity support. Cavity-nesters preferred soft snags as nest sites. Floodplain woodlands supported higher densities of breeding birds than upland woodland or herbaceous habitats. Bird species richness increased ($P<0.01$) with the width of wooded riparian habitats. Wooded habitats supported a maximum of 32 species; herbaceous habitat, 8. Observation frequencies of 41 bird species in 6 general habitat types were used to calculate indices of tolerance to habitat alteration. Microhabitat characteristics selected by each species were determined by comparing bird observation frequencies with 36 vegetation variables, using stepwise multiple regression. The potential effects of 6 alterations to wooded riparian habitats on the 41 species are predicted.

614

Stauffer, D.F.; Best, L.B.
Nest-site selection by cavity nesting birds of riparian habitats in Iowa.
Wilson Bulletin 94:329-337 1982

KEYWORDS: cavity-nesting birds;bird-habitat relationships;habitat selection;cavity-tree characteristics;riparian forest;Iowa USA

ABSTRACT: Nest-site selection by 10 cavity-nesting species was analyzed on the basis of five nest-site variables. Discriminant analysis showed considerable separation among nest-sites of 6 of the 10 species, mainly on the basis of nest substrate size. The other four species potentially compete for nest-sites. When analyzed separately, primary cavity nesters and secondary cavity nesters exhibited different patterns in nest-site partitioning. Woodpecker species chose different nest-sites mainly on the basis of support-structure height, whereas secondary cavity nesters primarily segregated nest-sites on the basis of cavity height. Differences in four of the five variables and results of discriminant analysis suggest that SCN were not randomly choosing cavities abandoned by woodpeckers.

615

Stelfox, J.G.;
Effects of clear-cut logging and scarification on wildlife habitats in west-central Alberta.
Canadian Wildlife Service, Western and Northern Region. Unpubl. report 176 p. 1984

KEYWORDS: clearcutting;silviculture;scarification;vegetation succession;avian succession;bird-habitat relationships;avian diversity;management implications;white spruce;lodgepole pine;mixed-forests;Alberta

ABSTRACT: Studies of vegetative development, coniferous regeneration and wildlife habitat use were conducted over a 27 year period following clear-cut logging in white spruce, lodgepole pine and mixedwood forests of west-central Alberta. Tooth-blade scarification retarded forest succession in the spruce and mixedwood clear-cuts but dozer-crushing of slash advanced succession in the pine clear-cut. Conifer growth and anticipated harvest volumes were reduced by scarification in the spruce and mixedwood clear-cuts but were increased in the pine clear-cut. Unscarified clear-cuts, especially within spruce and mixedwood forests, supported higher densities of big game, furbearers, tree cavity-dwelling birds and mammals, and many insectivorous birds during the first 27 years after logging. There were strong negative correlations between wildlife abundance and both wind chill and animal visibility. Conversely, there were positive correlations between wildlife abundance and both tree height and coniferous crown closure. Snowshoe hare damage to 25 year-old pine was greater in the scarified than in the unscarified clear-cuts. Tooth-blade scarification appeared detrimental for both forestry and wildlife in the spruce and mixedwood clear-cuts while crushing of slash appeared beneficial for forestry and benign for wildlife in the pine clear-cut.

616

Stevens, L.E.; Brown, B.T.;Simpson, J.M.;Johnson, R.R.
The importance of riparian habitat to migrating birds.
Pp. 156-164 in: Johnson, R.R. and Jones, D.A. ed. Importance, preservation, and management of riparian habitat: A symp. USDA For. Serv. Gen. Tech. Rept. RM-43. 1977

KEYWORDS: riparian habitat;staging areas;migratory passerines;habitat selection;avian diversity;foraging behaviour;management implications

ABSTRACT: Seven pairs of study sites in riparian and adjacent, nonriparian habitats were censused for spring migrant passerines. Riparian plots contained up to 10.6 times the number of migrants per hectare found on adjacent, nonriparian plots. Stop-over habitat selection is indicated by differing migrant densities and species diversities in various habitats. Passerine migration strategies are discussed.

617

Stewart, R.E.; Aldrich, J.W.
Ecological studies of breeding bird population in northern Maine.
Ecol. 30: 75-82. 1949

KEYWORDS: breeding birds;bird-habitat relationships;timber harvest;forest succession;avian diversity;avian density

ABSTRACT: *The nesting bird populations of the forests in the spruce zone of the Cheat Mountains, West Virginia, are made up of predominantly of species characteristic of the Boreal coniferous forest far to the north. However, other species characteristic of deciduous forests or of forests of more southern climates were found associated with them in smaller numbers, thus indicating the ecotonal or transitional nature of the areas studied. The cutting of spruce forests on the Cheat Mountains apparently has little effect in changing the faunal affinities of the bird populations of the area, although the population density is somewhat reduced.

However, when the cutting of these forests is followed by fire, a deciduous forest type develops and takes the place of the spruce, causing very noticeable changes in the species composition of the birds, as well as a marked lowering of population densities.

618

Stoddard, H.L. Sr.;
Bird habitat and fire.
Proc. Tall Timber Fire Ecol. Conf. 2:163-175 1963

KEYWORDS: fire;bird habitat;bird response

ABSTRACT: **An article discussing the relationship of fire and bird habitat. The role of fire in the ecosystem is examined, as is the direct attraction of fire to birds.

619

Strelke, W.K.; Dickson, J.G.
Effect of forest clear-cut edge on breeding birds in east Texas.
J. Wildl. Manage. 44:559-567 1980

KEYWORDS: breeding birds;avian diversity;avian density;bird-habitat relationships;clearcutting;habitat selection;management implications;mixed-wood forest;Texas USA

ABSTRACT: Breeding birds in 2 pine-hardwood stands (> 30 years old) and adjacent clear-cuts (<3 years old) in East Texas were censused from transects from 1 May to 26 June 1978 to determine if differences appeared in bird populations between woods edge and interior and between clear-cut edge and interior. Number of bird species (S), species diversity (H'), and abundance (A) were higher ($P<0.01$) in the 1st 25m of the woods edge than in other sections of the woods and clear-cut. The S, H', and A indices were similar in woods interior and in clear-cut edge and interior. Concentrations of woods-associated species appeared at the woods edge, species associated with clear-cuts used the woods edge for foraging and singing posts, and some species were found mostly in the edge. This prevalence probably resulted from the greater number of foliage layers at the edge and from simultaneous access by birds to more than 1 habitat type at the woods clear-cut juncture.

620

Stubblefield, T.C.;
Bird management - effects on timber management.
Pp. 302-310 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: bird management;timber management;silviculture;stand examination;logging method;thinning;forest fuel management

ABSTRACT: Proper analysis of the reciprocal effects of bird management and timber management requires a basic understanding of the individual resource complexities and acknowledgement of individual resource values. Effects should be estimated over time and on a site-specific basis to adequately reflect a most probable measure of their impact. In timber sale project planning, the timelines of this input to the analysis process is generally critical to the quality of the end product.

621

Styskel, E.W.;
Problems in snag management implementation - a case study
Pp. 24-27 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: snag management;timber harvest;logging;silviculture;thinning;fire;management implications;economics;Arizona USA

ABSTRACT: Providing suitable snags over time for dependent wildlife within intensively managed forests is an extremely complex task. Problems encountered in achieving this goal include: (1) moderate responsiveness by accountable personnel; (2) determining and following snag status; (3) minimizing timber yield reductions; (4) imprecise "longevity" data for standing snags; and (5) protecting snags and live replacements from natural and man-caused loss. Techniques used to overcome some of these obstacles are discussed.

622

Swallow, S.K.;
Primary cavity-site selection by birds.
J. Wildl. Manage. 50:576-583 1986

KEYWORDS: snags;snag management;cavity-nesting birds;cavity-tree characteristics;forest diversity;habitat selection;bird-habitat relationships;management implications

ABSTRACT: Current recommendations for snag management, which focus on characteristics of individual snags or stocking levels in forests managed for timber production, not only obscure the importance of forest characteristics surrounding a potential nesting site but also fail to meet the management objectives or abilities of the small landowner. During the summers of 1978 and 1979, a random sample of 816 snags (standing dead trees) was studied in central New York. Sixty-seven percent of the sample was in mature maple-ash-elm, the remainder was in 2nd growth woodland. A set of 21 characteristics of snags and 19 characteristics of forest sites was analyzed to determine which best predicted bird use. Use was defined as the presence of >=1 bird cavity in a snag or a forest site. Forest characteristics were sampled in randomly located 0.049 ha circles (N=61) in 1979. Stepwise logistic regression revealed that forest characteristics (total snag basal area, tree species diversity, and number of tree species) were more reliable predictors of bird use than were snag characteristics (diameter at breast height [dbh], amount of bark, height, and species). Snag management based on selecting suitable forest sites and on maintaining or creating suitable snags within those sites is recommended. Use of logistic regression models by field managers is discussed.

623

Swift, B.L.; Larson, J.S.;DeGraff, R.M.
Relationship of breeding bird density and diversity to habitat variables in forested wetlands.
Wilson Bull. 96:48-59 1984

KEYWORDS: breeding birds;avian density;avian diversity;bird-habitat relationships;forest structure;foraging guilds;deciduous forest;Massachusetts USA

ABSTRACT: Breeding bird populations were studied in eight deciduous forested wetlands located in the Connecticut Valley region of Massachusetts. Singing male birds were counted on 10 circular 0.25 ha plots in each study area in June 1978 and 1979. A total of 46 species was observed, with estimated densities varying among study areas from 134-720 males per 40 ha. Avian community parameters (total breeding bird density, bird species richness, and abundance of three foraging guilds) were related to 15 habitat variables by multiple regression and simple correlation. Results suggested that breeding bird communities in forested wetlands are significantly related to vegetation structure and hydrology. Generally, the most poorly drained sites appeared to have the most abundant and diverse breeding bird populations.

624

Szaro, R.C.;
Factors influencing bird populations in southwestern riparian forests.
Pp. 403-418 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: riparian forests;vegetation characteristics;avian diversity;avian density;bird populations;bird-habitat relationships;recreation;forest fragmentation;management implications

ABSTRACT: Riparian forests comprise only a minor portion of the available habitat in the arid Southwest, but supports extremely high bird populations. Most birds show a remarkable dependency on water related habitat for breeding areas, wintering areas, and migratory corridors. Bird communities in riparian forests are affected by vegetation type,structure, density, temporal fluctuations, adjacent habitat, recreational use, grazing, and location.

625

Szaro, R.C.; Balda, R.P.
Effects of harvesting ponderosa pine on nongame bird populations.
USDA For. Serv., Rocky Mount. For. and Range Exper. Stat., Research Paper RM-212. 8 p. 1979

KEYWORDS: timber harvest;silviculture cut;clearcutting;thinning;shelterwood;mitigation;avian communities;post-logging response;avian diversity;avian density;pine: ponderosa;management implications;Arizona USA

ABSTRACT: *The forest manager can remove between one-sixth and two-thirds of the available foliage of the ponderosa pine forest either in strips (and probably in blocks) or by thinning without detrimentally affecting the breeding bird community in terms of species richness, density, and diversity. Increased densities on silviculturally cut and irregular strip shelterwood plots are probably at least partially due to openings. However, forest treatments must consider that the quality of the bird community on cut and control areas are not equal. Species found on the control plot, such as the hermit thrush, red-faced warbler, western fly-catcher, and pygmy nuthatch, are replaced on the cut areas by species such as the western wood pewee, yellow-rumped warbler, and rock wren. When forests are managed for tree and/or water yield, some specific guidelines can be followed to minimize the impact of habitat modification on bird populations.

626

Szaro, R.C.; Balda, R.P.
Selection and monitoring of avian indicator species: an example from ponderosa pine forests in the southwest.
USDA For. Serv., Rocky Mtn. For. and Range Exp. Stn., Gen Tech. Rep. RM-89. 8 p. 1982

KEYWORDS: avian indicator species;species monitoring methods;variable circular-plot method;silviculture cut;strip cut;thinned cut;avian diversity;bird-habitat relationships;management implications;pine: ponderosa;Arizona USA

ABSTRACT: A critical discussion of the factors involved in selecting an indicator species is highlighted by the examination of a case study. The pygmy nuthatch and violet-green swallow are suggested as indicator species for lightly cut to old growth southwestern ponderosa pine. The monitoring of avian species could best be accomplished by the variable circular-plot method.

627

Szaro, R.C.; Balda, R.P.
Relationships among weather, habitat structure, and ponderosa pine forest birds.
J. Widl. Manage. 50: 253-260. 1986

KEYWORDS: avian community structure;avian diversity;avian density;bird-habitat relationships;clearcutting;post-logging response;weather effects;pine: ponderosa;Arizona USA

ABSTRACT: Avian community structure during the breeding season in a ponderosa pine forest of northern Arizona was influenced by weather and a series of timber harvest treatments. Fewer birds and bird species were present after a winter with the heaviest snowfall on record and low temperatures than after milder winters. Bird density was greater ($P < 0.05$) on the light and medium cut plots than on the untreated plot. A cluster analysis of bird densities over plots and the 3 year study period indicated treatment effects were more important in determining bird community composition than weather effects.

628
Taber, R.D.; Manuwal, D.;West, S.D.;Raedeke, K.J.;deCalesta, D.
Wildlife management in the mesic-temperate forest of Washington and Oregon.
Pp. 575-587 in: Proceedings of the XVII IUFRO World Congress. 1981

KEYWORDS: forestry-wildlife relationships;clearcutting;roads;site preparation: burning;plantation;rotation period;thinning;culling;fertilizing;wildlife: effects on;temperate forests;management implications;Washington USA;Oregon USA

ABSTRACT: In western Washington and Oregon most of the landscape is forested and most wildlife species are adapted to some type of forest environment. The two major influences on the forest and its fauna are the conversion of old-growth to managed younger forest, and the practices of intensive forest management. The effects of both influences are known in a general way for certain vertebrate species. Examples of current studies of forest succession and snag culling on birds, and sewage-sludge fertilization and harvest patterns on big game are presented. On public lands the integration of wildlife planning with forest management is mandated and guidelines are being prepared, but most of the necessary basic research remains to be done.

629
Takekawa, J.Y.; Garton, E.O.;Lanelier, L.A.
Biological control of forest insect outbreaks: the use of avian predators.
Trans. N. Am. Wildl. and Nat. Resourc. Conf. 47:393-409 1982

KEYWORDS: insect outbreaks;biological control;avian predators;foraging behaviour;studies review;management implication

ABSTRACT: *Objective evaluation of biological control management must weigh the benefit of using birds against the cost of increasing avian densities over a long period. Simulation modeling may be used to imitate the growth of stands subject to periodic pest outbreaks. The difference between predicted yields with and without birds could be used to evaluate the economic worth of avian predation. Recent budworm studies suggest that certain small areas having favorable microclimates may harbor pockets of the budworm. These populations increase to pandemic levels when favorable conditions allow rapid population growth. If these centers are responsible for outbreaks, biological control management may be applied very efficiently in small areas to achieve population regulation over extensive regions.

630
Taylor, C.M.; Taylor, W.E.
Birds of upland openings.
Pp. 189-197 in: R.M. DeGraaf and K.E. Evans, tech. coord. Management of north central and northeastern forests for nongame birds. Workshop Proc., Jan 23-25, 1979, Minneapolis, Minnesota. USDA For. Serv. Gen. Tech. Rept. NC-51. 1979

KEYWORDS: forest openings;nongame birds;avian species;avian densities;forest management;management implications

ABSTRACT: Northern forest openings are variable in vegetative life form. Eighty species of nongame birds are associated with forest openings or edge of forest openings in Northern Michigan. Current management is reviewed and suggestions for additional management practices and studies are included.

631
Taylor, D.L.;
Biotic succession of lodgepole pine forests of fire origin in Yellowstone National Park.
Ph.D. diss. Univ. Wyo., Laramie. 320 p. 1969

KEYWORDS:

ABSTRACT: not reviewed

632

Taylor, D.L.;
Some ecological implications of forest fire control in Yellowstone National Park, Wyoming.
Ecology 54:1394-1396 1973

KEYWORDS: fire;ecological implications;vegetation succession;avian fauna;fire suppression;management implications;Wyoming USA

ABSTRACT: Seven areas that were burned in Yellowstone National Park in 1966, 1960, 1954, 1942, 1910, 1856, and about 1665 were studied from 1965 through 1967 in order to document the trends of biotic succession in the development of lodgepole pine communities. Results indicate that there was an increase in the numbers of plant, bird, and mammal species during the first 25 years followed by a decrease in the older communities. The data indicate that elimination of forest fires will limit ecological diversity within the Park by reducing or eliminating certain plants and animals that are present only in the successional communities present before closure of the forest canopy.

633

Taylor, D.L.;
Forest fires and the tree-hole nesting cycle in Grand Teton and Yellowstone National Park.
Pp. 509-511. In: Proc. First Conf. Sci. Res. Natl. Parks, vol. 1. (New Orleans, La. 1976) U.S. Dep. Interior, Natl. Park Serv. Trans. Series 5 1979

KEYWORDS: post fire response;woodpeckers;bluebirds;habitat selection;bird-habitat relationships;management implications;Wyoming USA

ABSTRACT: *As a part of ongoing research on fire ecology and in response to public interest in the Waterfalls Canyon forest fire, long-term studies were initiated in Grand Teton National Park in 1974. This paper examines the tree-hole nesting cycle and shows that at least three bird species, the northern three-toed woodpecker, black-backed-three-toed woodpecker and mountain bluebird are fire-associated species in north-western Wyoming. Three-toed woodpeckers depend upon forest fires to create favorable habitat, and mountain bluebirds depend upon three-toed woodpeckers and hairy woodpeckers for nesting sites. Without forest fires, populations of the three species will be reduced or possibly eliminated from the parks.

634

Taylor, D.L.; Barmore, W.J. Jr.
Post-fire succession of avifauna in coniferous forests of Yellowstone and Grand Teton National Parks, Wyoming.
Pp. 130-145 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: avian ecology;avian diversity;avian density/biomass;foraging behaviour;fire: effects of;post-fire response;avian succession;coniferous forest;Wyoming USA

ABSTRACT: Yellowstone and Grand Teton National Parks have been zoned to allow certain natural fires to burn until they self-extinguish. The effect of these natural fires on avifauna in the two parks is reported in this paper. Breeding bird populations on burned lodgepole pine or spruce-fir-lodgepole pine forests of the following post-fire ages are analyzed: Moderate burn 1, 2, 3 years; severe burn 1, 2, 3, 5, 7, 11, 13, 17, 25, 29, 43, 45, 57, 61, 111, 300, 304, years; unburned spruce-fir with some lodgepole pine and unburned spruce-fir. Highest populations and greatest biomass occurred from 5-29 years post-fire. Bird density, species composition, and diversity on moderately burned spruce-fir-lodgepole were more like those on unburned spruce-fir than on other seral stages. Greatest biomass of air-soaring, foliage-seed, timber-drilling, ground-insect, and ground-seed feeding categories occurred where the forest canopy had not closed. Biomass of foliage-insect and timber-searching was greatest where the forest canopy had closed. Canopy closure affected avifauna more than fire did.

635

Telfer, E.S.;
Logging as a factor in wildlife ecology in the boreal forest.
For. Chron. 50: 186-190. 1974

KEYWORDS: forest succession;edge;clearcutting;forest structure;habitat suitability;wildlife ecology;boreal forest;Canada

ABSTRACT: Extensive stands of boreal forest in the late successional stages provide suitable habitat for some birds and for caribou but are unsuitable for many other species. Deer, moose, beaver, ruffed grouse and many other birds and mammals require the greater food production during the period of early regrowth following fire or logging. Wildlife species also require some dense, closed forest for shelter, therefore a diversity of forest types and age classes within their home ranges at all times of year is most beneficial. Logging can be used as a tool to provide diversity but much more research on boreal forest ecology is required to provide the basis for multiple-use management.

636

Telfer, E.S.;
The impact of forest management an wildlife in the northern and eastern forests of Canada.
In: Proceedings of the XVI IUFRO World Congress. 1976

KEYWORDS: wildlife: impacts on;forest management;timber harvest;clear-cutting;site preparation;regeneration;stand conversion;fire: suppression;pesticides;herbicide;rotation period;Canada

ABSTRACT: Regions discussed are the Boreal, Great Lakes - St. Lawrence and Acadian Forest Regions. Prevailing methods of harvesting, site preparation, regeneration, tending and protection of stands are discussed by major groups of cover-types with the region. Clear felling is the greatest problem in the Boreal Forest Region. Other problems are habitat loss in mature forests, truncating natural succession by eliminating mature forest habitat with dead trees. Boreal Forest regeneration often involves site preparation which destroys remaining trees. Truncation of early, forage producing, successional stages may result from artificial regeneration. In the southeastern forests the principal impact on wildlife stems from attempts to control insects particularly outbreaks of spruce budworm. In all regions regeneration increases the coniferous monoculture compared to a mixed original forest. Fire suppression has been increasingly effective with mixed impacts on wildlife.

637

Telfer, E.S.;
Forest practices and wildlife on experimental watersheds at Hinton, Alberta.
Canadian Wildlife Service, Edmonton, unpubl. 91 p typescript 1977

KEYWORDS: clearcut;patch cut blocks;avian diversity;avian abundance;Alberta

ABSTRACT: *Bird species occurrence was compared by Chi-square analysis for uncut blocks, blocks partially cut in patches and the completely-logged block. For the purpose of this analysis a unit was devised that consisted 100 m of transect walked in a day. The number of 100 m-day units was then used to calculate an expected value for number of bird species seen on the various blocks. Thirteen species were observed on the uncut block, 23 species on the blocks partially cut in patches, and 12 species on the completely clear cut block. The Chi-square analysis showed no significant difference in the number of bird species to be found in blocks harvested at the three intensities encountered. It is recognized that the bird survey techniques were limited and crude and that a more detailed investigation might produce different results. However, it has been suggested by A.H. Erskine that variation in the vertical crown volume is less important to boreal forest birds than it has been reported to be at more southerly latitudes in deciduous and mixed deciduous-coniferous forest.

638

Telfer, E.S.;
Energy production, wildlife and the complete forest concept.
Canadian Wildlife Service, Edmonton. Unpublished Report. 17 p. 1978

KEYWORDS: forest management;habitat alteration;forest wildlife;cavity-nesting birds;snag removal;management implications

ABSTRACT: The prospect of world petroleum shortages has renewed interest in wood as a raw material for energy and chemical production. Many of the same products can be obtained from both wood and petroleum while wood has the advantage of renewability. Intensive management of forests to produce maximum biomass yields would change habitat for forest wildlife on a vast scale. Four forest management alternatives are examined in increasing order of intensity. Potentially serious impacts for forest wildlife include removal of snags needed by cavity-nesting species, reduction of areas of stands of good snowcatching ability needed by wintering deer. Wildlife damage to expensive growing stock is expected to grow increasingly serious as management intensifies.

639

Telfer, E.S.;
Impact on wildlife of land management alternatives for the Alberta East Slopes.
Pp. 301-391 in: R.H. Swanson and P.A. Logen, eds. Alberta Watershed Research Program Symp. Proceed., 1977. Can. For. Serv. Rep. NOR-X-176. 343 pp. 1977

KEYWORDS: forest management;clearcutting;two-stage removal;residue removal;edge creation;snow pack management;avian diversity;cavity nesting birds;management implications;Alberta

ABSTRACT: Wildlife discussed includes big game mammals, furbearers, small mammals, forest grouse and nongame birds. Emphasis is on comparison of the impact of five forest management alternatives on wildlife in the coniferous forests of the East Slopes of the Rocky Mountains in Alberta. Optimum management for water yield would create an interspersion of mature forest with permanently maintained openings which would have a width equal to the stand height and would comprise about 40% of the area. Conditions for big game, furbearers and birds should improve somewhat. Two-stage removal of old stands benefits most species at first but logging of residual stands removes needed habitat elements. Continuous clearcutting has the same effect. The optimum cutting pattern for wildlife would provide forest edge valuable to many species of birds and furbearers as well as big game and would produce greater bird species diversity by adding edge and early-successional habitat to mature forest. Animals that prefer mature forests, such as caribou and cavity nesting birds would suffer some loss of critical habitat but would not be eliminated by the snowpack management and wildlife management alternatives. The tentative nature of the hypotheses regarding animal reactions to forest conditions is stressed and study of individual species requirements urged. Scale of land treatment is regarded as a key factor determining the impact of the treatment.

640

Telfer, E.S.;
Research today for tomorrow's forests: Forestry-wildlife relationships in Canada.
Pp. 563-573 in: Proceedings of the XVII IUFRO World Congress 1981

KEYWORDS: forestry-wildlife relationships;timber harvest;pesticides;depredation;economics;Canada

ABSTRACT: Canada presents a contrast of highly developed industrial regions together with extensive resource - frontier areas. Forest management varies greatly in intensity and in impact on wildlife. As fully managed forests develop, impacts on wildlife will result from: clear felling; site preparation, leading to loss of large trees and dead trees as wildlife habitats; pesticide spraying. Other problems that will increase include lack of technology for cost efficient total resource inventories, animal damage to plantations and lack of techniques for economic analysis of multiple-use alternatives. Canadian experience suggests countries should: define responsibilities for natural resource research; design long term research on wildlife in forests; develop capability to predict impacts of forestry on wildlife; check prediction accuracy through monitoring; give careful consideration to management of limited scientific manpower for maximum efficiency.

641

Temple, S.A.; Maseman, M.J.;Ambuel, B.
The ecology and management of avian communities in mixed hardwood-coniferous forests.
Pp. 132-153 in: R.M. DeGraaf and K.E. Evans, tech. coord. Management of north central and northeastern forests for nongame birds. Workshop Proc., Jan 23-25, 1979, Minneapolis, Minnesota. USDA For. Serv. Gen. Tech. Rept. NC-51. 1979

KEYWORDS: avian ecology;avian communities;avian diversity;avian density;bird-habitat relationships;forest succession;avian succession;forest management;silviculture;even-aged management;clear cutting;intermediate cutting;uneven-aged management;management implications;mixed hardwood-conifer forests;North America

ABSTRACT: High horizontal diversity of vegetation in mixed hardwood-coniferous forests is identified as a key feature affecting avian communities. The extremely high bird species diversity of mixed forests is explained by patchiness of forest vegetation and selection of discrete habitat patches by birds that are typical of either more northerly or southerly forest types. Bird population densities, seasonality of avian communities, and impacts of succession on avian communities are interpreted in relation to forest ecology. Impacts of silviculture on avian communities are predicted, and modifications that favor diverse avian communities are suggested.

642

Theberge, J.B.;
Bird populations in the Kluane Mountains, southwest Yukon, with special reference to birds and fire.
Can. J. Zool. 54:1346-1356 1976

KEYWORDS: bird populations;avian diversity;avian density;bird-habitat relationships;fire: habitat effects;forest succession;avian succession;boreal forest;Yukon

ABSTRACT: Bird populations were studied in relation to vegetation communities in the Kluane Ranges, Yukon. Information on species diversity and abundance was collected on 39 linear 4 ha plots in eight communities by noting birds heard and seen on repeated walks over each plot. Bird populations in tundra and subalpine communities were dissimilar from the six lowland communities, the latter all showing a marked similarity (lowland willow shrub, upland willow shrub, spruce-poplar forest, mature spruce, riparian poplar forest, balsam poplar parkland). Communities with greatest species diversity also had greatest total abundance. The tundra ranked lowest in diversity and abundance. Subalpine, however, held a high number of species, reflecting its ecotone position. Subalpine was distinctive in having few species of intermediate density compared with the density-dominance structure of birds in the other communities. The close similarity between bird populations in the lowland communities, despite distinctive differences in vegetation species and structure, was due to the overriding presence of three species that remained abundant throughout succession: Dark-eyed junco, Swainson's thrush, and yellow-rumped warbler, which means that species not closely specialized to the vegetation predominate over most of the region.

643

Thomas, J.W., tech. ed.;
Wildlife habitat in managed forests: the Blue Mountains of Oregon and Washington.
USDA For. Serv., Agric. Handbook 553, Washington, D.C. 512 p. 1979

KEYWORDS: forest management;habitat management;planning framework;habitat;bird-habitat relationships;forest ecology

ABSTRACT: *This book is framework for planning, in which habitat is the key to managing wildlife and making forest managers accountable for their actions. This book is based on the collective knowledge of one group of resource professionals and their understanding about how wildlife relate to forest habitats.

644

Thomas, J.W.; Anderson, R.G.;Maser, C.;Bull, E.L.
Snags.
Pp. 61-77 In: J.W. Thomas, tech. ed. Wildlife habitats in managed forests: The Blue Mountains of Oregon and Washington. USDA For. Serv. Agric. Handbook 553. 1979

KEYWORDS: snags;snag succession;bird-insect relationships;snag requirements;cavity-tree characteristics;cavity-tree selection;cavity-nesting birds;management implications

ABSTRACT: *Snags provide a portion of the life support system for many species of plants, invertebrates, birds, and mammals. In the Blue Mountains, 39 bird and 23 mammals species use snags for nesting or shelter. These species can be divided into those that excavate their own cavities and those that occupy existing cavities. Cavities can occur naturally, be excavated, or be formed by the spaces under loose bark. Such cavities nearly always occur in dead or partly dead trees. In this chapter, snags are discussed as part of the forest ecosystem.

645

Thomas, J.W.; Crouch, G.L.;Bumstead, R.S.;Bryant, L.D.
Silviculture options and habitat values in coniferous forests.
Pp. 272-287 in: D.R. Smith, tech. coord. Proc. of the symposium on management of forest and range habitats for nongame birds. USDA For. Serv. Gen. Tech. Rept. WO-1. 1975

KEYWORDS: avian ecology;silviculture;bird-habitat relationships;land use impacts;clear cutting;selection cut;fire: prescribed;thinning;plantation;rotation period;bird-insect relationships;management implications

ABSTRACT: Different bird species select different types and stages of forests which satisfy their basic requirements for nesting and feeding. Birds are classified into groups based on their requirements (i.e., nests on the ground, feeds on the ground, etc.). The suitability of each bird group for each forest successional stage and the effect on birds of various silvicultural treatments at those stages was judged. The role of birds on insect population control and the effect of fire on habitat is examined.

646

Thomas, J.W.; DeGraaf, R.M.;Mawson, J.C.
Determination of habitat requirements for birds in suburban areas.
USDA For. Serv., Northeastern For. Exp. Stn., Research Paper NE-357. 15 pp. 1977

KEYWORDS: bird-habitat relationships;passerines;habitat requirements;habitat suitability;avian density

ABSTRACT: Songbird populations can be related to habitat components by a method that allows the simultaneous determination of habitat requirements for a variety of species. Through correlation and multiple-regression analyses, 10 bird species were studied in a suburban habitat, which was stratified according to human density. Variables used to account for bird distribution included aspects of vegetation, human activity, and structures.

647

Thomas, J.W.; Maser, C.;Rodiek, J.E.
Edges--their interspersion, resulting diversity and its measurement.
Pp. 91-100 in: R.M. DeGraaf, tech. coord. Proceedings of the workshop on nongame bird habitat management in the coniferous forests of the western United States. USDA For. Serv. Gen. Tech. Rept. PNW-64. 1978

KEYWORDS: edge;interspersion;forest structure;forest diversity;management implications

ABSTRACT: Edge can be a crude measure of overall diversity of any area. Diversity is considered as inherent (community/community) edge, induced (successional stage/successional stage) edge and total edge. Size of forest stands are related to expected wildlife diversity.

648

Thomas, J.W.; McCluskey, D.C.
Effects of aerial application of DDT for tussock moth control on nesting survival of mountain bluebirds and house wrens.
USDA For. Serv. Res. Pap. PNW-185, Pac. Northwest For. and Range Exp. Stn., Portland, Oreg. 37 pp. 1974

KEYWORDS: insecticides;DDT;bluebirds;house wrens;nesting survival;Oregon USA

ABSTRACT: *We detected no detrimental short-term effects on nestling survival of mountain bluebirds and house wrens on study areas sprayed with 0.75 lb DDT per acre subject to spray shut off and release over forest-grassland edges adjacent to grass-land areas greater than 2 acres in size.

649

Thomas, J.W.; Miller, R.J.;Black, H.;Rodick, J.E.;Maser, C.
Guidelines for maintaining and enhancing wildlife habitat in forest management in the Blue Mountains of Oregon and Washington.
Trans. North Am. Wildl. Nat. Resourc. Conf. 41:452-476 1976

KEYWORDS: forest management;snag management;bird-habitat relationships;cavity-nesting birds;management guidelines;mixed-wood forest;Oregon USA;Washington USA

ABSTRACT: *We hope we have demonstrated that there is enough information to make predictions about the welfare of most, if not all, vertebrates in relation to forest management decisions. Further, this information can be made available in a framework mutually useful to biologists and foresters. Such a system can be used in: (1) preparation of environmental impact statements, (2) land use planning, (3)judging consequences of silvicultural activities, (4) as a checklist, (5) as a brief summary of habitat preferences of the vertebrates, and (6) as a key to more detailed information on each species. The information can be computerized to yield rapid prediction of impacts of proposed alterations in the forest environment or to make predictions of wildlife populations in a managed forest over time. Further, the system can be updated easily as additional data become available.

650

Thomas, J.W.; Miller, R.;Maser, C.;Anderson, R.;Carter, B.
The relationship of terrestrial vertebrates to plant communities and their successional stages.
Pp. 281-303. in: A. Marmelstein, ed. Classification, inventory, and evaluation of fish and wildlife habitat. US Fish and Wildl. Serv. Publ. OBS-78176. 1978.

KEYWORDS: environmental impact assessment;land use planning;timber management;life forms;bird-habitat relationships;successional stages;vulnerability index;Oregon USA

ABSTRACT: Increasing demands for an accounting of environmental impacts caused by government actions has made necessary an appraisal of impacts on the entire vertebrate complex rather than on a few selected species. A system is described that relates species to forest plant communities and their successional stages. Information is presented at five levels of detail: (1) vertebrates are divided into "life forms" based on similar habitat requirements for feeding and reproduction; (2) individual species within life forms are examined based on habitat requirements for feeding and reproduction; (3) detailed biological data are presented for each species in terms of reproductive rate, season of occurrence, territory or home range, and orientation to special or unique habitat features; and (4) the three best literature citations on each species. Prediction of habitat conditions can then be translated into effects on wildlife.

651

Thomas, J.W.; Miller, R.J.;Maser, C.;Anderson, R.G.;Carter, B.E.
Plant communities and successional stages.
Pp. 22-39 In: J.W. Thomas, Tech. ed. Wildlife habitats in managed forests: The Blue Mountains of Oregon and Washington. USDA For. Serv. Agric. Handbook 533. 1979

KEYWORDS: plant communities;successional stages;bird-habitat relationships;foraging substrates;nesting sites;forest management;cutting practices;herbicides;fire: prescribed burns;planting;management implications;Oregon USA;Washington USA

ABSTRACT: *How the forest manager can deal wildlife-related problems in forest management planning is dealt with in this chapter. The system described is designed to handle a large volume of technical information about wildlife and their habitat in a way that makes sense to the forest manager. Steps include: 1) assembling pertinent data for forest wildlife species: 2) weigh the impact of timber management activities on wildlife; 3) wildlife habitats are identified in a way that they could be simultaneously considered with timber management activities. By associating individual wildlife species and groups of species with plant communities and their successional stages, the forest manager can translate standard forest inventories into information on wildlife habitats. Information on cavity-nesting birds is used to illustrate some of these concepts.

652

Thomas, J.W.; Ruggiero, L.F.;Mannan, R.W.;Schoen, J.W.;Lancia, R.A.
Management and conservation of old-growth forests in the United States.
Wildl. Soc. Bull. 16: 252-262. 1988

KEYWORDS: forest management;forest diversity;forest succession;forest structure;bird-habitat relationships;habitat suitability

ABSTRACT: *The harvest of old-growth forests for wood product sets back natural succession by removing forest stands that have a unique diversity of structure and function. Only 2-15% of the virgin forests that existed when European settlers arrived remain today. In the Pacific Northwest where the current debate over old-growth management is centered, about 17% of the old-growth that existed in the early 1800s remains. A number of wildlife species use old-growth forests disproportionately to their occurrence, but the degree of dependency on old growth is not well understood. While much of the old-growth debate emphasizes single species of wildlife, such as the northern spotted owl, the old growth management issue more appropriately involves complex and unique forest ecosystems. Management plans for providing old growth must be based on existing stands because replacement stands cannot be produced by silvicultural practices; they must come from stands that are allowed to develop naturally into old growth. We believe that a number of federal statutes mandate the preservation and maintenance of old growth as part of the managed forest. These dictates include the National Environmental Policy Act, the Endangered Species Act, and the National Forest Management Act. Continued reduction of old-growth forests may conflict with the intent of these statutes.

653

Tilghman, N.G.;
Managing urban woodlands for a variety of birds.
USDA For. Serv., Northeastern Station, NE-INF. 63-85. 8 p. 1985

KEYWORDS: urban woodlands;remnant forest;habitat selection;avian diversity;management recommendations

ABSTRACT: Remnant patches of woods provide urban dwellers with the opportunity to observe a wide variety of bird life without having to travel outside the city. Most of these urban woodlands are publicly owned and managed by the local parks department or conservation commission. This pamphlet looks at what can be done to promote utilization of these woodlands by a wide variety of birds.

654

Tilghman, N.G.;
Characteristics of urban woodlands affecting winter bird diversity and abundance.
Forest Ecology and Management 21:163-175 1987

KEYWORDS: forest islands;avian communities;avian diversity;forest size;forest characteristics;models;management implication;Massachusetts USA

ABSTRACT: Winter bird communities were studied in 1982 and 1983 in 32 forest islands surrounded by urban development. Forty-six bird species were recorded in these urban woodlands (twice as many as were found in residential areas in the same city in a previous study). Size of woodland, building density immediately adjacent to the woods, amount of edge, and distance to the nearest body of water were the forest island characteristics that best predicted the number of species present, explaining over 60% of the variation in multiple regression models. Equations using size of woodland, distance to the nearest body of water, amount of edge, and tree density explained between 46 and 49% of the variation in bird species diversity. Models for bird abundance only accounted for about 20% of the variation in these numbers with tree height, tree density, shrub density, distance to the nearest body of water, building density, and distance to the nearest trail being the most important variables. Eleven species of winter birds were more often found in the larger woodlands. Only the house sparrow was more abundant in the smaller woodlands. Management implications of these results are discussed.

655

Timber Management Division, ;
Proceedings of the national silviculture workshop: silviculture for all resources.
USDA For. Serv., Timber Management, Washington, D.C. 322 p. 1989

KEYWORDS:

ABSTRACT: not reviewed

656

Titterington, R.W.; Crawford, H.S.;Burgason, B.N.
Songbird responses to commercial clear-cutting in Maine spruce-fir forests.
Journal Wildl. Manage. 43: 602-609. 1979

KEYWORDS: clearcutting;post-logging response;forest succession;habitat selection;bird-habitat relationships;avian density;avian diversity;multivariate analysis;coniferous forest;Maine USA

ABSTRACT: In commercially clear-cut and uncut spruce-fir stands of northern Maine, the distribution of breeding songbirds was determined by habitat structure. We grouped 14 sampling areas into 5 seral stages. Stage I was characterized by dense slash and open ground, Stage II by dense raspberry stems and deciduous woody stems less than 2 m. tall, Stage III by deciduous woody stems 2.1-4.5 m tall, Stage IV by deciduous woody stems taller than 4.5 m and trees with dbh 10-15 cm, and Stage V by a dense softwood overstory. Presence or absence of a softwood overstory was the most important habitat feature. Each seral stage was dominated by a characteristic group of breeding bird species. The data showed a predictable pattern in response of the breeding avifauna to changes in habitat structure following clear-cutting.

657

Titus, R.;
Management of snags and den trees in Missouri - a process.
Pp. 51-59 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: snags;snag management;silviculture;even-aged management;clear-cutting;single tree selection;group selection;thinning;management implications;Missouri USA

ABSTRACT: The Missouri Department of Conservation and Mark Twain National Forest have been reviewing and refining standards and guides for managing wildlife habitat. An important part of this effort has been to more clearly define the biological basis for dens and snags and to develop management guidelines. A committee was assigned to review available literature on 89 species of birds, mammals, amphibians and reptiles known to require snags and/or den trees to meet their life history requisites in Missouri. Biological requirements were established for each major land use pattern and management techniques recommended for even-age and uneven-age silvicultural systems.

658

Todd, C.S.; Owen, R.B., Jr.
Management of bald eagle and osprey nest sites.
Pp. 141-148 in: J.A. Bissonette, ed. Is good forestry good wildlife management? Proc. of a Joint Conference, March 6-8, 1985, Portland, Maine. 1986

KEYWORDS: bald eagles;ospreys;nest-sites;snags;forest management;selective cuts;management implications

ABSTRACT: Ospreys and bald eagles exhibit variable nesting habits throughout their range but are regionally selective of specific nest locations. Both species frequently nest in dominant or supercanopy conifers, especially pines, in riparian zones. Osprey nests are typically atop snags or live trees with dead, broken tops. Eagles usually nest in or below an open, live crown. There is little economic loss from preserving such damaged or overmature trees, but effective local management must allow for maturation of replacements. Selective cuts, often prescribed or required in shoreland zones, may enhance an area's suitability as potential nesting habitat but sometimes specifically remove mature trees. Designation of appropriate trees or discrete stand components for old growth management is desirable. High fidelity to traditional breeding areas by these 2 species is justification for such a management investment.

659

Tramer, E.J.;
Bird species diversity: components of Shannon's formula.
Ecology 50:927-929 1969

KEYWORDS: avian ecology;avian diversity;forest structure;bird-habitat relationships;Shannon's formula;technique: diversity index

ABSTRACT: Shannon's diversity index H' was calculated for 267 breeding bird censuses. The index was resolved into its components, species richness and relative abundance, to determine which components played a larger role in the determination of diversity patterns. Changes in diversity were correlated closely with species richness (r=0.972), while the relative abundance component remained stable. Among the nine community types represented, diversity and species richness increased with the foliage height diversity. The relative abundance component was strikingly low in the marshes due to the presence of gregarious birds which nest in colonies and feed outside the community. Photoplankton differ from birds in that the relative abundance component is not stable from one collection to the next. This plankton inhabiting relatively uncertain environments and being 'opportunistic', while birds occupy predictable environments and are therefore 'equilibrium' species. The distribution of relative abundances in birds is more even than in trees, herbaceous-shrub communities, or phytoplankton. Since this is in part the result of intraspecific territoriality, it is predicted that in nonbreeding bird populations, species' relative abundances will be less even than they are during the breeding season. It is suggested that the regulation of diversity by either the species richness or relative abundance components represent alternative strategies which are suited to predictable/nonrigorous and unpredictable/rigorous environments, respectively. Therefore, differences similar to those observed between birds and phytoplankton might be expected in other groups of organisms.

660

Trial, H., Jr.;
Effects of insecticides on forest structure.
Pp. 309-314 in: J.A. Bissonette, ed. Is good forestry good wildlife management? Proc. of a Joint Conference, March 6-8, 1985, Portland, Maine. 1986

KEYWORDS: forest structure;insecticides;budworm;non-target animals;economics

ABSTRACT: **This paper will briefly summarize deleterious effects of past and present insecticides used against budworm. Results that can be expected with current technology and spray strategies will be discussed. Protection strategies used in Maine will be described and data will be presented to relate relative success of each strategy. Finally, the effects of not spraying will be summarized.

661

Tubbs, A.A.;
Riparian bird communites of the Great Plains.
Pp. 419-433 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: riparian habitat;avian diversity;avian density;migratory status;sensitive species;land use impacts;management implications;Great Plains Area USA

ABSTRACT: One hundred thirty-six birds utilizing riparian communities in the Great Plains are identified and categorized. Breeding birds restricted to riparian vegetation may outnumber obligates of other grassland communities sevenfold. Sensitive and other decreasing species are discussed. Grazing, water diversion, and land conversions are the most destructive impacts in the region. Wood-harvesting in riparian habitat is an increasing and potentially disastrous practice. Research needs and management are suggested.

662

USDA Forest Service, ;
Guidelines for management of cavity nesting habitat-woodpeckers.
USDA For. Serv., Lolo Natl. For., unpubl. memo, 3 p. 1973

KEYWORDS:

ABSTRACT: not reviewed

663

Van Horne, B.;
Density as a misleading indicator of habitat quality.
J. Wildl. Manage. 47:893-907 1983

KEYWORDS: technique: habitat assessment;habitat quality;density evaluation;habitat management

ABSTRACT: Current methods of evaluating wildlife habitat for management purposes can be arranged in a hierarchy of increasing generality. The most general level is evaluation of wildlife habitat for entire communities on the basis of inferences drawn from vegetational structure. At the base of the hierarchy the high resolution studies, upon which accuracy at higher hierarchical levels depends, usually assume that habitat quality for a species is positively correlated with the density of the species. If habitat quality for a wildlife species is a measure of the importance of habitat type in maintaining a particular species, habitat quality should be defined in terms of the survival and production characteristics, as well as the density, of the species occupying that habitat. Situations in which habitat quality thus defined is not expected to be positively correlated with density are described, along with the species and environmental characteristics that are most likely to produce these situations. Examples drawn from the literature in which density and habitat quality are not positively correlated are described. The positive correlation of density with habitat quality in specific instances cannot be assumed without supporting demographic data.

664

Varty, J.W.;

Environmental surveillance of insecticide spray operations in New Brunswick's budworm infested forests, 1977
Information Report M-X-87, Canadian Forestry Service, Dept. Fisheries and Environ. 1978

KEYWORDS: insecticides;ecological effects;environmental surveillance;avian populations;post-spraying responses;New Brunswick

ABSTRACT: (1) Aminocarb: No major impact was attributable to the operational spraying of aminocarb, in two independent surveys incorporating some 30 spp. of songbirds. The data do not reveal any immediate mortality or influence on song frequency among sparrows, warblers, kinglets, and others. Searches failed to find any dead or sick birds. Approximately 100 nests were located and no rearing failures could be linked to spraying. (2) Fenitrothion: The University of Moncton team detected no apparent effect on populations of 13 species of the most common forest-dwelling warbler species, (e.g. bay-breasted, ovenbird, blackburnian, and Tennessee warblers). Territory occupation by ruby-crowned kinglets decreased about 40% in treated plots, but it is not possible to draw firm conclusions because the sampling intensity was too light. (3) Phosphamidon: The census of bird song revealed no alteration of frequency except for a brief reduction in activity by white-throated sparrows. Plot searches did not reveal any dead or sick birds after experimental treatment in July. Two broods of nestlings (magnolia warbler, Swanson's thrush) were kept under observation, but appeared unaffected by the aerial sprays. In summary, the surveys revealed no influence on songbird survival in the sampled areas of operational and experimental spray treatments in 1977. There remains still some doubt as to the influence of fenitrothion on kinglets, probably the most vulnerable bird species.

665

Venables, L.S.V.; Venables, U.M.
The sequence of bird species in a young conifer plantation 1959-1967, Newborough Warren, Anglesey.
Nature Wales 11:176-183 1969

KEYWORDS:

ABSTRACT: not reviewed

666

Verner, J.;
Measuring responses of avian communities to habitat manipulation.
Studies in Avian Biology. No. 6:543-547 1981

KEYWORDS: habitat manipulation;avian response measurements;predicting/assessing effects;census: bird communities;habitat assessment;multivariate statistical analysis;trend estimates;variable-diameter circular plot method;management implications

ABSTRACT: Increasing concern for the need to conserve our renewable natural resources, including birds, has resulted in the enactment of laws and the involvement of federal agencies to protect these resources. Past assessments of the effects of management activities on avian communities, and of the sampling procedures used, have been limited in approach and unsatisfactory in result. Recent research suggests that, in addition to sampling bird communities, relevant habitat features must be sampled. Multivariate statistical analyses of many sample plots is usually a preferred technique, trend estimates are usually preferable to density estimates, and the variable diameter circular plot method is usually best suited for the inventory analyses needed by management.

667

Verner, J.;
Avian behavior and habitat management.
Pp. 39-58 in: D.R. Smith, tech. coord. Proc. of the symposium on management of forest and range habitats for nongame birds. USDA For. Serv. Gen. Tech. Rept. WO-1. 1975

KEYWORDS: avian behavior;mating systems;territoriality;dispersion;habitat selection;management implications

ABSTRACT: Implications of avian behavior in habitat management are assessed via literature survey. Territoriality, dispersity, and habitat selection are particularly germane to management policies. Consideration of each results in applicable management recommendations and targeted research needs, which are enumerated in the summary.

668

Verner, J.;
Bird communities of mixed conifer forests of the Sierra Nevada.
Pp. 198-223 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS:

ABSTRACT: Avian community composition in the various seral stages and canopy closure classes of mixed-conifer forests of the Sierra Nevada of California is examined from the standpoint of forest management. Comparison of field studies with predictions of a bird species-habitat association matrix suggests that managers can rely on information in the matrix when assessing responses of bird communities to changes in vegetation structure in the forest. Modern forest management practices have altered the structure and species composition of mixed-conifer forests in relation to pristine conditions. The most important change form the standpoint of bird communities is a substantial reduction in the amount of forest in mature to old-growth conditions. Several recommendations are made, some directly related to assurance of adequate acreages of mature and old-growth forest stands.

669

Wagner, J.L.;
Seasonal change in guild structure: oak woodland insectivorous birds.
Ecol. 62:973-981 1981

KEYWORDS: guild structure;insectivorous birds;niche breadth;migratory status;competition

ABSTRACT: The use of foraging sites by a foliage and bark gleaning guild of insectivorous birds was studied for 2 yr in a California oak woodland. Choices of plant type, perch size, and foraging height are presented for both residents and migrants in two contrasting seasons (fall/winter and spring). Seasonal differences were fewer than differences between years at the same season. Niche breadths and overlaps of residents in the 2nd yr of the study were mostly larger in spring than in fall/winter, although the contrasts were not statistically significant. The niche breadth findings are viewed as consistent with a prediction of optimal foraging theory that a broader range of patch types will be used when food is abundant. Dendrograms based on niche overlaps for fall/winter and spring showed that three resident species (Chestnut-backed Chickadee, Plain Titmouse, and Hutton's Vireo) constituted the core of the guild, together with two migrants in fall/winter (Ruby-crowned Kinglet and Yellow-rumped Warbler) and one in spring (Blue-gray Gnatcatcher). The foraging of residents was not influenced by the presence of different migrants at different seasons. Species most similar in foraging sites were distinct in bill size or behavior, except for the chickadee and the vireo. These two species are viewed as potential competitors.

670

Waide, R.B.;
Resource partitioning between migrant and resident birds: the use of irregular resources.
Pp. 337-352. in: A. Keast and E.S. Morton eds., Migrant Birds in the Neotropics: Ecology, Behavior, Distribution and Conservation. Smithsonian Instit. Press, Washington. 1980

KEYWORDS:

ABSTRACT: not reviewed

ABSTRACT: not reviewed

672

Weaver, M.; Kellman, M.
The effects of the forest fragmentation on woodlot tree biotas in Southern Ontario.
J. Biogeogr. 9: 199-210. 1981

KEYWORDS: forest fragmentation;forest structure;forest diversity;Ontario

ABSTRACT: Certain patterns of island biogeographic theory were tested in Southern Ontario woodlots. The tree populations (> 4 cm dbh) of 10 old growth woodlots were censured and each species in every woodlot assigned to one of three demographic classes (persisting, invading, going extinct). The dominant pattern of flux in all woodlots was that of species extinction, as predicted by island biogeographic theory. However, those species going extinct were mainly shade-intolerant, suggesting that succession, rather than forest fragmentation, may have been responsible for their disappearance. This was confirmed by multiple correlation analyses that showed no effects of area or isolation upon the numbers of species going extinct or upon the number of species persisting in woodlots. Instead, the results indicated that woodlots containing more species were losing more and that this loss was most severe in topographically diverse woodlots. The latter effect was interpreted to be the result of decreased illumination in these woodlots, due to mutual shading of adjacent slopes by canopy trees. The results suggest that disturbance is an important species enrichment mechanism in these forest communities.

673

Webb, W.L.;
Songbird management in a northern hardwood forest.
Trans. N. Amer. Wildl. and Natur. Resourc. Conf. 42:438-448 1977

KEYWORDS: songbird management;individual species management;avian diversity;avian communities;management intensity;clearcut;selection cut;hardwood forest;New York USA

ABSTRACT: The question of how to manage populations of forest dwelling songbirds is dealt with at four levels: (1) data on individual species management is discussed, (2) an examination of whether avifauna groups can be identified and used in management is made, (3) the effects of management intensity on the entire songbird fauna is examined, and (4) general principles of songbird management are suggested.

674

Webb, W.L.; Behrend, D.F.;Sarworn, B.
Effect of logging on songbird populations in a northern hardwood forest
Wildl. Monogr. 55: 35pp 1977

KEYWORDS: avian ecology;avian diversity;avian indicator species;logging;bird-habitat relationships;post-logging responses;hardwood forest;management implications;New York USA

ABSTRACT: Counts of breeding birds were conducted for a 10 year period in 5 large stands of the northern hardwood forest type in the Adirondack Mountains of northeastern New York State to determine effect of logging. From 25 to 100 percent of merchantable timber volume was removed on each of 4 areas, while 1 uncut stand served as a control. Since the majority of observations were birds heard but not seen, and since there was no way to determine accurately the distance from observer to singing bird, the data are used as an index to population rather than as a population density measurement. The bird fauna of the uncut area remained stable for the decade of the investigation, therefore, it served as a valid experimental control. The northern hardwood forest type appeared to have a breeding bird fauna of rather constant composition under all canopy conditions, from undisturbed to heavily disturbed. None of the species studied were eliminated by logging, but a few were recorded only in logged stands. Numbers of species and diversity indices were higher in logged areas, and were positively correlated with increased logging intensity. Analysis of response of individual species was made on the 26 most frequently observed species (of a total of 56). Those included more than 92% of all individuals counted on any area. Based on several methods of analysis, it appears that 11 species were not affected by logging, finding all 5 stands equally suitable habitat. Eight species responded positively to logging, being more abundant on logged areas than on the control. Half of those responded only to the heaviest logging levels and half responded with progressively increasing numbers as logging intensity increased. They were species that found environment improved by opening of crown canopy and increased growth of low vegetation. Seven species responded negatively to logging, being less abundant on logged areas than on the uncut control area. Those included 2 species that utilized resources of a dense mature canopy and were reduced by any logging, 2 species that were progressively reduced as logging intensity increased, and 3 species not affected by light logging but were reduced by heavy logging intensities. Several species showed trends in population over the decade of the study, most of which appeared to indicate a return to population levels characteristic of uncut forest. The timing of these trends suggests that postlogging responses of the breeding bird fauna are short lived in relation to the long intervals between harvest cuttings in this forest type in this region.

675

Wein, R.W.; Riewe, K.R.;Methven, I.R., eds.
Resources and dynamics of the boreal zone.
Proceedings of a conference held at Thunder Bay, Ontario, August, 1982. Association of Canadian Universities for Northern Studies. 1982

KEYWORDS: boreal forest;resources;dynamics

ABSTRACT: **A series of papers which cover a variety of topics related to aspects of the boreal forest ecosystem.

676

Welsh, D.A.;
Impact on bird populations of harvesting the boreal mixed wood forest.
Pp. 155-167 in: R.D. Whitney and R.M. McClain, cochairmen. Boreal mixedwood symposium. O-P-9. Can. For. Serv., Dept. Environ. 1981

KEYWORDS: logging;selective cutting;post-logging response;avian diversity;avian density;migratory status;bird-habitat relationships;boreal mixedwood forest

ABSTRACT: The boreal mixedwood forest has a rich breeding bird community of 150 species. Most are migrants and many winter in the tropics. Density and richness are controlled principally by factors not directly affected by selective cutting. Harvesting results in dramatic bird species shifts, some of which may be irreversible.

677

Welsh, D.A.;
Use of the mapping method to study the effects of forest cutting on boreal bird populations.
Pp. 8-12 in: Purroy, F.J. ed. Bird Census and Mediterranean Landscape. Leon 1983

KEYWORDS: avian community organization;avian diversity/richness;avian density;boreal forest;timber harvest;bird-habitat relationships;conservation implications;Ontario

ABSTRACT: *Habitat alteration is a major factor affecting bird populations. Since 1978 the Canadian Wildlife Service in Ontario has been studying the effect on bird populations of cutting the boreal forest. Bird communities studied appear to exhibit patterns that can be readily related to topographic position and cutting history. Lowland sites where all trees are removed at harvesting time are more simple than uplands where selective cutting occurs. Birds in cutover forests are accordingly best understood by separating selectively cut from clearcut sites. Most bird species show distinct distribution patterns in relation to variables associated with forest cutting. To have sound conservation input into forest management plans ornithologists must develop a good knowledge of the forest industry as well as avian ecology.

678

Welsh, D.A.;
The influence of forest harvesting on mixed coniferous-deciduous boreal bird communities in Ontario, Canada.
Acta Oecol. 8:247-252 1987

KEYWORDS:

ABSTRACT:

679

Welsh, D.A.;
Meeting the habitat needs of non-game forest wildlife.
The Forestry Chronicle 64:262-266 1988

KEYWORDS: nongame wildlife;nongame wildlife-forestry interactions;avian communities;forest succession;avian succession;management systems available

ABSTRACT: This paper deals with: (1) what is non-game wildlife, (2)who is responsible for non-game wildlife, (3) non-game wildlife-forestry interactions, and (4) examines the problems of trying to develop management plans for non-game wildlife.

680

Welsh, D.A.; Fillman, D.R.
The impact of forest cutting on boreal bird populations.
American Birds 34:84-94 1980

KEYWORDS: boreal forest;timber harvesting;cutover habitat;habitat composition;avian associations;avian species;Ontario

ABSTRACT: Each year almost one half million acres of the boreal forest of Ontario are cut. As part of its Migratory Birds Programme the Ontario Region of the Canadian Wildlife Service is studying the effect of forest harvesting practices on migratory bird populations. The paper describes 22 forest regions of various composition and ages, and those bird species associated with each area.

681

West, G.C.; DeWolfe, B.B.
Populations and energetics of Taiga birds near Fairbanks, Alaska.
Auk 91:757-775 1974

KEYWORDS: avian ecology;avian diversity;avian density;avian metabolics;habitat diversity;taiga;Alaska

ABSTRACT: *The birds present in two adjacent areas of taiga in interior Alaska were censused from late May to the end of August using a modification fro the trail census method of Emlen (1971). On area A we found 48 species, 22 of which were regular inhabitants and on area B, 23 species, with 10 regular inhabitants. Area A was characterized by greater habitat diversity than area B. The resting metabolic rate during daytime was measured on 11 species of regular inhabitants and the total amount of energy needed for existence, reproductive activities, and molt were estimated. At both census sites the population and estimated energy removal increased in July and decreased again in August. In general the higher numbers in July were a result of production of young; the decrease in August was a result of mortality and emigration from the census area. The total numbers of breeding birds and their biomass were less on the two sites censused than those reported in other localities within the boreal forest from Northwest Territories, southern Ontario, or northern Minnesota.

682

Westworth, D.A.; Brusnyk, L.M.;Burns, G.R.
Impact on wildlife of short-rotation management of boreal aspen stands.
Unpublished report prepared by D.A Westworth and Associates Ltd. for Canadian Forestry Service. 145 pp. 1984

KEYWORDS: timber harvest;short rotation;clearcutting;post-logging response;habitat succession;bird-habitat relationships;avian succession;avian density;snags;management implications;Alberta

ABSTRACT: A study was initiated in west-central Alberta in 1981 to determine the potential effects of short-rotation harvesting of boreal aspen stands on wildlife. The study involved a comparative evaluation of habitat conditions and wildlife use of aspen stands of different ages, including 1 and 2 year old clearcuts and 14, 30, 60, and 80 year old stands. Changes in habitat structure between different successional stages resulted in a successional replacement of bird species with stand age. Overall densities of breeding birds would likely increase under short-rotation management, however approximately one-third of the species common to aspen forests would undergo a significant decrease in abundance. The absence of large diameter snags in managed stands would result in a pronounced decrease in abundance of snag dependent birds. Browse production was highest in the 14 year old stands while maximum production of grasses and forbs occurred in the 14 and 30 year old stands respectively. As a result, short-rotation harvesting would be beneficial to ungulates as long as management programs include silvicultural options designed to meet the cover requirements of each species. Among the furbearing mammals, some species are expected to benefit while others would be adversely affected. Snowshoe hares, beaver, lynx, coyotes and wolves would likely benefit while species such as marten, fisher and red squirrel would be adversely affected by a reduction in the amount of aspen succeeding to mixedwood or coniferous forest under short-rotation management.

683

Wetmore, S.P.; Booth, B.
A reconnaissance of bird communities in old-growth coastal hemlock forests, British Columbia.
Canadian Wildlife Service, Pacific and Yukon Region, Technical Report Series No. 14. 16 pp. 1886

KEYWORDS: avian populations;breeding birds;old-growth forest;secondary growth;clearcuts;forest diversity;cavity-nesting birds;bird-habitat relationships;coniferous forest;British Columbia

ABSTRACT: A reconnaissance survey of bird populations in coastal hemlock old-growth forest was conducted in 1983. The main objectives were to assess the similarities between bird populations in undisturbed old-growth western hemlock forests and those found in: (1) western hemlock residuals and (2) mountain hemlock forest at higher elevation. We found that populations in undisturbed western hemlock and western hemlock residuals were similar. Populations in higher elevation mountain hemlock forests were different. We conclude that future work should focus on the capacity of managed second-growth western hemlock forests to support old-growth bird communities and on the status of cavity nesters in managed second-growth and high elevation mountain hemlock forests.

684

Wetmore, S.P; Keller, R.A.;Smith, G.E.S.
Effects of logging on bird populations in British Columbia as determined by a modified point-count method.
Can. Field-Nat. 99:224-233 1985

KEYWORDS: clearcutting;avian communities;avian diversity;avian density;bird-habitat relationships;post-logging response;coniferous forest;British Columbia

ABSTRACT: Breeding bird populations in mature Mountain Hemlock and in Engelmann Spruce Subalpine Fir forests and clearcuts were surveyed in 1982. In steep, valley-oriented Mountain Hemlock forests the uncut strip of timber up-slope of the clearcuts supported the same bird communities as did continuous forest extending from below alpine to the valley bottom. In Engelmann Spruce-Subalpine Fir forests, bird communities in unlogged stands between clearcuts were similar to those in large uncut areas. In forests where clearcut logging occurs there is a net loss to mature forest bird populations; however, in residual stands the bird communities continue to exist at similar densities. Also, logging results in a different bird community which occupies the clearcuts. A single-visit modified point-count method was developed for censusing the rugged, heavily forested terrain. The method combines feature of the Finnish line transect and point-count methods. Densities estimated were similar to those obtained in other studies conducted in the northwestern United States and southern British Columbia.

685

Whitcomb, B.L.; Whitcomb, R.F.;Bystrak, D.
Island biogeography and "habitat islands" of eastern forests. III. Long-term turnover and effects of selective logging on the avifauna of forest fragments.
Am. Birds 31:13-19 1977

KEYWORDS: forest fragmentation;selective logging;forest-interior birds;edge species;bird habitat relationships;avian diversity;avian density;avian turnover;conservation implications

ABSTRACT: *High breeding bird densities observed in two fragments of mature forest are ascribed to (1) high soil fertility with resultant high carrying capacity, (2) an available avian species pool that includes most of the original forest specialist species, and (3) a local biogeographic context of interrelated forest fragments sufficient to support the entire species pool, including wide ranging woodpeckers and raptors. Selective logging of one of the tracts increased species richness in the short run, but the long term prospects for such destabilized forests are uncertain. Two forest interior species, worm-eating warbler and black-and-white warbler, were present in the undisturbed tract in 1947 and absent in 1975. Their absence can be viewed as one type of "turnover" (local range reaction). Other species present in the South Tract in 1947, but absent in 1975 or 1976 may reasonable be expected to recolonize in future years. However, most turnovers and changes in densities of forest-interior specialists paralleled regional tendencies for loss of neotropical migrants and may portend future, more drastic changes in species composition.

686

Whitcomb, R.F.;
Island biogeography and "habitat islands" of western forest. I. Introduction
Am. Birds 31:1-3 1977

KEYWORDS: habitat islands;forest fragmentation;avian ecology;migratory species;conservation implications

ABSTRACT: *Thousands of contiguous acres may be required to assure the long-term survival of the forest-interior bird species. If sizes of this magnitude are involved, we can be reasonably confident that the preserves will also be adequate for the preservation of the vast majority of the many thousands of species of living organisms which comprise the forest community. Thus, imperatives for avifaunal preservation should be an important consideration whenever planners threaten to limit the size of regionally significant preserve areas.

687

Whitcomb, R.F.; Robbins, C.S.;Lynch, J.F.;Whitcomb, B.L.;Klimkietwicz, M.K.;Bystrak, D.
Effects of forest fragmentation on avifauna of the eastern deciduous forest.
Pp. 125-205 in: Burgess, R.L. and D.M. Sharpe eds., Forest island dynamics in man-dominated landscapes. Springer-Verlag, New York, NY. 1981

KEYWORDS:

ABSTRACT: not reviewed

688

White, R.P.;
Biogeographic factors affecting the wintering distributions of nearctic avian migrants in the Neotropics.
Ph.D. Thesis. The Univ. of Wisconsin, Madison, 243 p. 1987

KEYWORDS:

ABSTRACT: not reviewed

689

Whitfield, D.W.A.; Gerrard, J.M.;Maher, W.J.;Davis, D.W.
Bald eagle nesting habitat, density, and reproduction in central Saskatchewan and Manitoba.
Can. Field-Nat. 88:399-407 1974

KEYWORDS: bald eagles;habitat selection;reproduction;nest size;density;bird-habitat relationships;mixed-wood forest;Manitoba;Saskatchewan

ABSTRACT: A bald eagle population breeding in the boreal forest region of central Saskatchewan and Manitoba is described. The primary nesting habitat of these eagles is a narrow strip, about 200 yards wide along the shores of the major lakes and rivers. Aerial surveys in 1969 covering 14 subregions of the study area showed that there were 0.083 + 0.030 breeding areas per mile of primary habitat searched. We estimated the total population of the Saskatchewan part of the study area to be 1592-7970 at midsummer. It is likely that these eagles contribute significantly to the wintering population in the midwestern United States. The productivity of the population appears to be sufficient for maintenance at the existing level.

690

Whitney, R.D.; McClain, K.M., eds.
Boreal mixedwood symposium.
COJFRO Symposium Proceedings O-P-9. Canadian Forestry Service, Dept. of Environ. 1981

KEYWORDS: boreal mixedwood;habitat;forest ecology;forest dynamics

ABSTRACT: **Various aspects of the boreal mixwood forest are presented by papers in symposium.

691

Wiens, J.A.;
Nongame bird communities in northwestern coniferous forests.
Pp. 19-31 in: R.M. DeGraaf, tech. coord. Proceedings of the workshop on nongame bird habitat management in the coniferous forests of the western United States. USDA For. Serv. Gen. Tech. Rept. PNW-64. 1978

KEYWORDS: avian ecology;avian communities;avian diversity;avian density/biomass;avifauna stability;foraging behaviour;habitat alterations;logging;fire: prescribed/wild;coniferous forests;management implications

ABSTRACT: Northwestern coniferous forests contain relatively rich breeding avifaunas. Censuses record an average of 15.4 breeding species, and a total of 71 species are listed from 29 censuses. Only 8 of these species occur with great regularity in the censuses, however, and most of these are widely distributed over North American coniferous forests. Total breeding densities and standing crop biomasses are relatively high in Northwestern forests. The avian community is dominated by foliage-feeding insectivores, although these forms contribute a smaller proportion of the avifauna than in other North American coniferous forests. Northwestern forest bird communities undergo considerable seasonal and yearly change in composition and species abundances. If these forest habitats are to be managed for the well-being of nongame birds, we must: 1. discard the notion that diversity per se is an appropriate goal; 2. reach a better understanding of the habitat requirement of the native species, and identify forms that may be good indicators of habitat deteriorations; and 3. determine the proper areas of habitat blocks that enhance the success of the most important bird populations or species assemblages.

692

Wiens, J.A.;
Avian communities, energetics, and functions in coniferous forest habitats.

Pp. 226-265 in: D.R. Smith, tech. coord. Proc. of the symposium on management of forest and range habitats for nongame birds. USDA For. Serv. Gen. Tech. Rept. WO-1. 1975

KEYWORDS: avian ecology;avian communities;avian distribution;avian diversity;avian density;avian succession;habitat alteration;pesticides;bird-insect relationships;fire;logging;management implications

ABSTRACT: North American coniferous forests contain relatively rich breeding avifaunas. Censuses taken in 5-25 ha plots record 6-32 breeding species, with the "richest' avifaunas occurring in Northeastern, Southeastern, and Sierra Nevada forests. On the average, 17-27 per cent of all individuals present in a plot belong to the single most abundant ("dominant") species; these species are frequently broadly distributed over North American coniferous forest regions. Breeding densities in various forest regions average 329-1456 individuals/square km, while standing crop biomass averages 65-283 g/ha; values are greatest in Pacific Northwest forests, and lowest in immature stages of Northeastern forests. In most regions, there are substantial annual variations in avian density and biomass. Ecologically, foliage-feeding insectivores overwhelmingly dominate the avifaunas of forests in the Northeast, the Southeast, and the North, but their proportionate contribution to density and biomass decreases toward the West and Northwest. In many Northeastern forests, more than half of the individuals present in a stand are warblers, while in most western forests less than 10 per cent of the individuals are warblers. Energy flow through breeding avifaunas in western Oregon coniferous forests varies from 10.5 to 20.8 Kcal per sq m per breeding season. Roughly 80 percent of the energy flow is obtained from animal prey, chiefly foliage insects. Consumption of foliage insects and seeds may constitute a major functional role of birds in forest ecosystems, especially in relation to pest insect population dynamics and to reforestation processes.

693

Wight, H.M.;
Nongame wildlife and forest management
Pp 27-38. In: H.C. Black, ed. Wildlife and forest management in the Pacific Northwest. Oregon State Univ., Sch. For., For. Res. Lab, Corvallis. 1974

KEYWORDS: nongame wildlife;forest birds;forest management;silviculture;rotation period;chemical control;thinning;clearcutting;climax species;cavity-nesting species;forest succession;avian succession;management implications;Oregon USA

ABSTRACT: Nongame wildlife are the most numerous wild vertebrates found in forest communities. In this paper, I discuss the relative importance of this group of animals and cite Oregon Birds as examples of most of the principles discussed. Forest-management activities affect the species composition and abundance of forest birds by altering natural habitats and changing the relative composition of successional stages of forests. The variety of successional stages of the forest community provides the habitats for a rich variety of bird life. Certain birds are associated largely with early stages of forest succession. Other species favor intermediate and late stages. Only rarely is a bird adapted so broadly as to be found in all seral stages. Examples I give are of birds associated with the various seral stages of the Douglas-fir zone of western Oregon and forests of eastern Oregon excluding the driest areas. Birds that require special attention from forest managers are those that nest in holes. Intensive forest management does not foster the production or retention of the snags that are so important for this group of birds. A policy of snag preservation will assist over the short term, but dedication of certain living trees that normally would be culled seems the only way snags can be assured for the long term. I discuss forest-management practices such as shortened rotations, chemical control of herbaceous vegetation, precommercial and commercial thinning, overstory removal, and clearcutting, as they may affect bird life. In general, these practices reduce the diversity of habitats provided by subclimax and climax woodlands. These species are in the most precarious state of all forest birds, because shortened rotations will preclude the reestablishment of such stands, and these birds do not possess the adaptiveness that would allow them to adjust to younger stands for nesting and foraging.

694

WILCOVE, D.S.;
Forest fragmentation and the decline of migratory songbirds.
Ph.D. Thesis, Princeton University, Princeton, N.J. 127 p. 1985

KEYWORDS: forest fragmentation;forest size;migratory songbirds;avian diversity;nest predation;conservation implications;USA

ABSTRACT: Many species of migratory songbirds are disappearing from small woodlots and urban parks throughout the eastern United States. I have investigated four hypotheses to explain these declines: the loss of winter habitat in Latin America, higher rates of nest predation in the smaller tracts, the increased proportion of forest edge to forest interior in small tracts, and brood parasitism by cowbirds. I repeated old (1947-48) breeding bird censuses from the Great Smoky Mountains National Park to determine whether declines have also occurred in extensive, undisturbed forest tracts. In general, populations of migratory songbirds have not changed significantly since 1947-48. Since the loss of wintering habitat should affect songbirds in both large and small woodlots, this finding suggests that the current declines result from fragmentation of the breeding habitat. To study nest predation, I placed artificial nests with quail eggs in forests of different sizes in Maryland and Tennessee. Predation rates were higher in small woodlots than in large tracts. Predation was especially intense in woodlots near suburban neighborhoods compared to woodlots in isolated rural areas. Nests on the ground were more vulnerable to predators than nests in shrubs, and open-cup nests were more vulnerable than cavity nests. Since most migratory songbirds construct open-cup nests, and several species place them on the ground, migratory songbirds should be strongly affected by the higher predation rates in small woodlots. Within a large tract, the rate of nest predation declines steadily from the edge to 600 m inside the forest. Thus the high proportion of forest edge in small woodlots contributes to the decline of migratory songbirds. Cowbirds now occur in all but the largest forest tracts in the eastern United States. They are most common in woodlots with large numbers of potential hosts, most of which are migratory songbirds. These results indicate that the conservation of migratory songbirds is best achieved by the establishment of large forest preserves. The optimum shape for these preserves is circular.

695

Wilcove, D.S.;
Nest predation in forest tracts and the decline of migratory songbirds
Ecology 66:1211-1214 1985

KEYWORDS: avian ecology;migratory songbirds;habitat suitability;forest size;forest fragmentation;nest predation;conservation implications;Tennessee USA;Maryland USA

ABSTRACT: Nest predation has been suggested as an important cause of the decline of breeding populations of migratory songbirds in small woodlots in eastern North America. I tested this hypotheses by placing artificial nests with fresh quail eggs in forests of different sizes in Maryland and Tennessee. Predation rates were higher in small woodlots than in large tracts. Predation was especially intense in woodlots near suburban neighborhoods compared to woodlots in isolated rural areas. Experimental open-cup nests were more vulnerable to predators when placed on the ground vs. 1-2 m above ground. In either position these open-cup nests were more vulnerable to predators than experimental cavity nests. Since most species of migratory songbirds construct open-cup nests, and several species place them near the ground, migratory songbirds should be strongly affected by higher predation rates in small forest tracts.

696

Wilcove, D.S.;
Public lands management and the fate of the Spotted Owl.
Am. Birds 41:361-364 1987

KEYWORDS: spotted owl;old-growth forest;habitat requirements;logging impacts;forest fragmentation;management implications;North America

ABSTRACT: "Two decades ago, the spotted owl was one of the least known, least studied birds in North America. Today it is the subject of intensive study, rancorous debate, and legal battles. This sudden notoriety stems from the owl's specialized habitat requirements in the western portion of its range, where it inhabits old-growth conifer forests. These same forests are worth hundreds of millions of dollars to the timber industry, which is logging them at a rapid rate.

697

Wilcove, D.S.; Terborgh, J.W.
Patterns of population decline in birds.
Am Birds 38:10-13 1984

KEYWORDS: bird populations;migratory status;habitat alteration;avian density;population declines;bird-habitat relationships

ABSTRACT: "We believe these patterns of population declines are of more than historical interest. They indicate that the first signs of a decline may come at the periphery of a bird's range or in the center, in marginal habitat or in optimal habitat. Furthermore, the dispersal behavior and population structure of some species will tend to obscure population changes, making the detection of a decline that much more difficult. Given these possibilities it may be unrealistic, for example, to expect all of the regional compilers of the Blue List to agree on the status of a species. Indeed, if our goal is early detection of a decline, it would be dangerous to list only birds for which there was unanimous agreement among the compilers. If individual observers monitor the local avifauna in a variety of habitats (to ensure that both marginal and optimal habitats are covered for many species), and if compilers are alert to regional trends, we stand a better chance of promptly detecting a bird in trouble. As conservationists our best policy must be a conservative one-to regard any chronic decline as a matter of considerable concern. To do otherwise is to gamble with the fates of our threatened birds.

698

Williams, J.B.;
Habitat utilization by four species of woodpeckers in a central Illinois woodland.
Am. Midl. Nat. 93:354-367 1975

KEYWORDS: woodpeckers;habitat utilization;sympatric guild;foraging behaviour;tree characteristics selection;competition;Illinois USA

ABSTRACT: A sympatric guild consisting of the red-headed woodpecker, the downy woodpecker, the red-bellied woodpecker, and the yellow-bellied sapsucker segregated realized niches by: (1) differential foraging techniques; (2) exploiting different height classes; (3) selection of different tree species; (4) use of relative different amounts of alive and dead substrate; (5) differential selection of limb size.

700

Williamson, K.;
Birds and modern forestry.
Quart. J. For. 64:346-355 1970

KEYWORDS: avian density;avian diversity;bird-habitat relationships;habitat alteration;plantations;forest structure;conservation implications;Great Britain

ABSTRACT: This article describes census studies carried out by the B.T.O. Populations Section in Forestry Commission properties in the Chilterns. The density and diversity of bird-life, particularly among summer visitors, are high where young conifer plantations are surrounded by a 'landscape fringe' of mature deciduous trees (Homefield Wood, Bucks.), and where 'island refuges' of deciduous trees and scrub, about an acre in size are allowed to remain when the ground is clear-felled and replanted with conifers (Hoo Wood, Herts.). Experience on Rhum, Inner Hebrides, in 1969,shows that the same principle could be profitably employed to diversify the habitat and enrich the bird-life in the extensive new forests of Sitka spruce and other exotic conifers which are gradually replacing the doomed fragments of native deciduous woodland in northern and western Scotland.

701

Williamson, K.;

The conservation of bird life in the new coniferous forests.
Forestry 45:87-100 1972

KEYWORDS: avian diversity;avian density;passerines;bird-habitat relationships;habitat alteration;plantations;conservation implications;Great Britain

ABSTRACT: The bird-life of the British Isles is largely based on a deciduous forest climax and the status of many species could be endangered by the current trend towards a mainly coniferous regime. This paper reports on the first five years of a long-term study of the habitat requirements of a woodland bird population during a period of change from broadleaved trees to a planting dominated by conifers, and recommends a compromise in management which while not too demanding from the economic standpoint, will enable much of our original woodland avifauna to adapt to the radical transformation which forest cover is likely to undergo in the future.

702

Willner, G.R.; Gates, J.E.;Devlin, W.J.
Nest box use by cavity-nesting birds.
Am. Mild. Nat. 109:194-201 1983

KEYWORDS: nest box use;cavity-nesting birds;nest box location;discriminant function-analysis

ABSTRACT: Nest boxes were investigated for use by cavity-nesting birds at the Carey Run Sanctuary, Garrett Co., Maryland. These boxes provided nesting sites for the eastern bluebird, house wren, and tree swallow. Boxes at the Beltsville Agricultural Research Center, Prince Georges Co., Maryland, provided sites for the eastern bluebird, house sparrow, and tufted titmouse. Twenty-four box and habitat variables were measured at each location. Six variables were used in discriminant function analysis to segregate the boxes used by the three bird species at Carey Run. Bluebirds tended to use boxes where herb height was less than at boxes used by house wrens or tree swallows. Distance to nearest tree, sapling and shrub, and distance and dbh of the nearest tree in front of the box were least at boxes used by house wrens and greatest at tree swallow boxes. Bluebird boxes were intermediate. A discriminant function model developed for Carey Run was used to classify nest boxes at Beltsville. About 81% of the eastern bluebird nest boxes, the species common to both sites, were classified correctly at Beltsville. Use of nest boxes by the eastern bluebird can be enhanced by placing them in the correct habitat configuration. Discriminant function analysis could be a useful management tool for evaluating nest box locations prior to undertaking an extensive nest box program.

703

Willson, M.F.;
Avian community organization and habitat structure.
Ecology 55:1017-1029 1972

KEYWORDS: avian community;foraging guilds;avian diversity;avian biomass;forest structure;bird-habitat relationships;Illinois USA

ABSTRACT: Bird species diversity was linearly correlated with foliage height diversity and curvilinearly with total percent vegetation cover. The addition of trees in a vegetational series has a disproportionate effect on the addition of species, primarily by the addition rather than the expansion of guilds. No basic relationship of species-packing within guilds is associated with bill or body size except frequently within two-member guilds. Estimated abundance and biomass of birds does not appear to be related to productivity of the habitats, in contrast to reports from the literature. Similarity of bird species composition is not related to similarity of foliage distribution, when like study areas are compared. Avifaunas of grasslands generally differed more among themselves than did those of forests. Bird species overlaps were correlated with foliage height overlaps only for part of the variational range for two- and three- layered habitats, and little if at all for grasslands. Width of "habitat-niche" is not related to numerical dominance, taxonomic or ecological categories. Because many of these results do not coincide with previous attempts at ecological generalization, great care in such attempts seems strongly indicated. Studies should be made of meticulously delineated subcommunities, resource measurement, and reproductive success, as well as events in the nonbreeding season.

704

Willson, M.F.;
The breeding distribution of North American birds: a critique of MacArthur (1959).
Wilson Bull. 88: 582-587. 1976

KEYWORDS: migratory birds;breeding birds;avian density;avian diversity;bird-habitat relationships;habitat selection

ABSTRACT: *A partial reanalysis of MacArthur (1959) has shown that 1) North American neo-tropical migrants are less prevalent in grasslands than forests (as MacArthur also showed) but that there is no significant difference in the proportion of neotropical migrants in deciduous and coniferous forest (unlike MacArthur's results); 2) coniferous forests have relatively fewer year-round resident individuals than grasslands or deciduous forest, and grasslands and coniferous forests have slightly fewer resident species than deciduous forests; 3) most neotropical migrant birds breed primarily in deciduous forest and most of those that breed in coniferous forest are parulides. The results suggest that seasonal changes in available food resources may be effective less in deciduous forest than in coniferous (in contrast to MacArthur's conclusion). Possible ecological bases for the habitat differences are suggested, but remain to be demonstrated.

705

Winkler, D.W.; Dana, G.
Summer birds of a lodgepole-aspen forest in the southern Warner Mountains, California.
West. Birds 8:45-62 1977

KEYWORDS: avian diversity;avian density;migratory status;foraging behavior;nest-site;bird-habitat relationships;lodgepole-aspen forests;decadent aspen;management implications;California USA

ABSTRACT: The initial findings of this study have potentially significant land management implications. The decadent stands of aspen are apparently of great importance in maintaining the bird populations on the plot. Not only is aspen important as a source of potential nest sites for hole-nesting species, but it appears that the insect populations associated with the aspen are very important for both breeding birds and transients. Aspen stands probably become more susceptible to disease and insect infestation as they grow older. As a result, it may seem senseless to many land managers to retain old and relatively unattractive stands of aspen which may act as potential reservoirs of infestation for neighboring stands. At least some decadent stands, however, must be maintained until land management personnel better understand the requirements of bird populations that aspen stands of varying ages can satisfy over the variations of the changing seasons and year to year fluctuations. Much the same considerations apply to lodgepole forest. The management of forests for heterogeneous age composition should be given the highest consideration in weighing management alternatives until more is known about the relationship between bird populations and the state of their habitat.

706

Winternitz, B.L.;
Temporal change and habitat preference of some mountain breeding birds.
Condor 78: 383-393. 1976

KEYWORDS: breeding birds;habitat selection;avian density;avian diversity;edge-effects;bird-habitat relationships;Mixed-wood forest;Colorado USA

ABSTRACT: *Avian density averaged 93 pairs/40 ha, representing an average of 22 breeding species and 11 visitor species yearly. Although 50 species were present in the area, only 78% of these were present in any one year. Most breeding species showed constant yearly densities, and the seven dominant species totalled over 50% of the breeding pairs. Relative density of most species changed within the breeding season. Some species increased in numbers while others decreased. High relative densities were strongly related to vegetation type while low densities were not. A temporal spacing of nesting activity by the different species indicated a partitioning of the breeding season. It also reflected subdivision of food resources and feeding manner. Woodpecker numbers may limit the densities of other hole-nesting species. Bird species showed strong vegetational preferences, especially for aspen. Fewest birds were found in Douglas-fir and Mixed Forest. Edge and patchiness did not seem to raise relative densities. Tests indicated aspen itself was responsible for high density. Aspen areas probably support most birds because of high food availability and the presence of nest holes.

707

Winternitz, G.L.;
Birds in aspen.
Pp. 247-257 in: R.M. DeGraaf and N.G. Tilghman, eds. Workshop proceedings: management of western forests and grasslands for nongame birds. USDA For. Serv. Gen. Tech. Rept. INT-86. 1980

KEYWORDS: avian diversity;avian density;aspen: montane;forest structure;edge effect;inserts;Fomes;Colorado USA

ABSTRACT: The bird populations of three Colorado montane aspen stands are compared in an attempt to determine what factors are responsible for high bird density and diversity found in aspen. The ecological factors considered in this study are: 1. the effect of surface water, soil moisture, and slope; 2. the effect of the vegetation, including the aspen, the understory, aspen fungi disease, and the edge effect in aspen stands; 3. other biotic effects, including insect levels in the aspen understory, aspen fungal disease, and variation in the feeding habits of the birds. The results of this study indicate that the insect fauna of aspen stands, and fungal infection of the trees, are the controlling agents governing bird density and diversity.

708

Winternitz, B.L.; Cahn, H.
Nest holes in live and dead aspen.
Pp. 102-106 in: J.W. Davis, G.A. Goodwin, and R.A. Ockenfels, tech. coord. Snag habitat management: proceedings of the symposium. USDA For. Serv., Rocky Mt. For. and Range Exp. Stat., Gen. Tech. Rept. RM-99. 1983

KEYWORDS: aspen;nest holes;nest hole-tree characteristics;fungus infection

ABSTRACT: A comparison of three studies in two Colorado montane aspen stands indicated that almost 40% of birds breeding in aspen used nestholes. Over 50% of the nesthole trees were infected by Fomes igniarius conks. Nesthole trees were larger than the other aspen, and estimated to average well over 100 years in age.

709

Wood, G.W.; Niles, L.J.
Effects of management practices on nongame bird habitat in longleaf-slash pine forests.
Pp. 40-49 in: R.M. DeGraaf, tech. coord. Proc. of the Workshop: management of southern forests for nongame birds. Jan 24-26, 1978, Atlanta, Georgia. 1978

KEYWORDS: timber management;nongame bird habitat;silviculture;cutting: regeneration;fertilization;clear cutting;fire: prescribed;thinning;cutting: salvage/sanitation;pine: slash;management implications

ABSTRACT: Increase in numbers of habitat niches that develop with increasing stand complexity is important to raising the species richness and abundance of nongame birds in longleaf and slash pine forests. Some silvicultural practices decrease complexity while others increase it. Practices which lead to eradication of the understory, destruction of dead trees and generally promote monoculture appear to be deleterious to nongame bird populations.

710

Wood, G.W.; Niles, L.J.;Hendrick, R.M.;Davis, J.R.;Grimes, T.L.
Compatibility of even-aged timber management and red-cockaded woodpecker conservation.
Wildl. Soc. Bull. 13:5-17 1985

KEYWORDS: red-cockaded woodpecker;foraging behaviour;nesting success;territory size;clearcutting;even-aged management;conservation implications;South Carolina USA

ABSTRACT: Background data on 6 clans of red-cockaded woodpeckers consisted of: 3,176 movement locations, 21,280 foraging observations, and 3 seasons of nesting success information collected in 1 annual plus 2 additional nesting seasons when movement data were not collected. Following preliminary studies, portions of territories were clear-cut in early winter at levels of 0, 7, 11, 20, 22, and 37% of the annual territory area. Subsequent movement and foraging observations during 1 annual plus 1 winter/spring and 1 nesting period totalled 4.099 locations and 21,706 foraging observations. Nesting success was observed for 3 seasons after cutting. Standard statistical analyses failed to show any influence of level of cutting on magnitude of size change in territory area, potential foraging area, or high-use area within territories. When clan responses were grouped according to lightly vs. heavily cut sites, the relative increase in the annual territory approximated the relative amount of annual territory area, potential foraging area, and amount of pine basal area removed by clear-cutting. No other relationships between level of cutting and changes in movements or habitat use were suggested. In addition, the data did not indicate that cutting has any effect on numbers of nestlings surviving to the immediate prefledging period. Management for sustained populations of red-cockaded woodpeckers appears compatible with ever-aged timber management with economically acceptable rotation lengths within a forest.

711

Yahner, R.H.;
Structure, seasonal dynamics, and habitat relationships of avian communities in small even-aged forest stands.
Wilson Bull. 98:61-82 1986

KEYWORDS: clearcut;even-aged stands;forest fragmentation;bird-habitat relationships;avian communities;avian structure;avian stability;foraging guilds;management implications;Pennsylvania USA

ABSTRACT: Structure, stability, and habitat relationships of avian communities associated with small even-aged stands were studied for three consecutive winters and breeding seasons in aspen and mixed-oak cover type in an area managed for ruffed grouse habitat. Thirteen and 69 species were noted in six habitat types during winter and the breeding season, respectively. Trunk-bark foragers predominated in winter, particularly in uncut habitats; in contrast, the ground-shrub foraging guild predominated in the breeding season, especially in clearcut habitats. The six habitat types were segregated in two groups (uncut and clearcut) on the basis of stability of the trunk-bark and ground-shrub foraging guilds in winter and the breeding season, respectively. Habitat variables describing overstory trees and snags were among those important to trunk-bark and sallier-canopy foraging guilds; variables describing shrub and understory vegetation were associated with the ground-shrub foraging guild. The habitat fragmentation created by the current cutting cycle has had no discernible negative impact on the avifauna, and the species adapted to early-successional habitats have benefited.

712

Yahner, R.H.;
Short-term avifaunal turnover in small even-aged forest habitats.
Biol. Consev. 39:39-47 1987

KEYWORDS: avian communities;logging;post-logging responses;avian diversity;short-term avifaunal turnover;forest succession;avian succession;even-aged forest;Pennsylvania USA

ABSTRACT: Turnover rates of avian communities during three consecutive breeding seasons were compared among six habitats created for ruffed grouse management via forest clearcutting. Habitat size had minimal effect on turnover rates because each habitat selected for study consisted of 3 ha (three 1 ha stands). Degree of isolation of habitats also did not affect turnover of species composition. However, stage of vegetative succession presumably resulted in high turnover rates in the youngest clearcut habitat. Rates declined in clearcut oak habitat compared to clearcut aspen habitat of similar age. In mature aspen habitat on the treated (managed) sector of the study area, rates were affected by proximity to young clearcut habitats. The occasional occurrence of three uncommon species intolerant of forest fragmentation combined with relatively high species richness were factors influencing high turnover rates in habitat on the control (uncut) sector.

713

Yahner, R.H.; Scott, D.P.
Effects of forest fragmentation on depredation of artificial nests.
J. Wildl. Manage. 52:158-161 1988

KEYWORDS: forest fragmentation;clearcutting;edge-effects;avian ecology;breeding birds;nest depredation;Pensylvania USA

ABSTRACT: Depredation on artificial ground and arboreal (1.5 m above ground) nests was studied in mature (uncut) forest stands on a ruffed grouse management area in central Pennsylvania from May to August 1986. Predation was evaluated in mature stands with zero, 25, and 50% zones of the surrounding forest fragmented by clearcutting. Nest depredation was highest in the 50% zone and least in the zero percent zone; more arboreal nests than ground nests were disturbed. American crows were major predators on nests in the 50% zone, and crows and blue jays caused most nest disturbances in the 25% zone. Our results suggest that fragmentation of surrounding mature forest stands may negatively impact avian nesting success, especially when the principal nest predators are corvids. Predation in fragmented forests may have a greater effect on nesting success of birds nesting above ground than on those nesting at ground level.

714

Yamasaki, M.; Tubbs, C.
Wildlife tree management in New England Northern hardwood forests.
Pp. 109-134 in: J.A. Bissonette, ed. Is good forestry good wildlife management? Proc. of a Joint Conference, March 6-8, 1985, Portland, Maine. 1986

KEYWORDS: forest management;wildlife tree production;snags;cavity-nesting birds;cavity-tree selection;management implications

ABSTRACT: The concept of "wildlife tree management" sometimes conflicts with perceptions of long-term stand/area management considerations. How wildlife and timber managers view and treat individual habitat components within much larger management systems can: (1) change rapidly given a range of possible management emphases, and (2) complicate on-the-ground attempts to implement common goals for wildlife habitat and timber production. Management strategies for wildlife tree production in the northern hardwood types are described. Criteria for selecting wildlife trees in northern hardwoods, silvicultural considerations, and financial aspects of integrated wildlife tree management and timber management objectives are discussed.

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Yeager, L.E.;
Two woodpecker populations in relation to environmental change.
Condor 57:148-153 1955

KEYWORDS: woodpeckers;environmental change;flooding;bark beetle outbreak;bird-insect relationships;foraging grounds;cavity sites;Illinois USA

ABSTRACT: *Environmental changes in the two forest types involved were due to flooding in Illinois and to a bark-beetle outbreak of unprecedented violence in Colorado, covering a gross area of about 600,000 acres. Both phenomena led to the death of vast numbers of trees, thousands of deciduous hardwoods in the midwest bottomlands and millions of conifers in the mountains. Death of these stands resulted in nearly limitless foraging grounds and cavity sites for use by resident woodpeckers.

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Zarnowitz, J.E.;
The effect of forest management on cavity-nesting bird populations in the Olympic National Forest, Washington.

M.S. Thesis, Univ. Washington, Seattle. 111 p. 1982

KEYWORDS:

ABSTRACT: not reviewed

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Zarnowitz, J.E.; Manuwal, D.A.
The effects of forest management on cavity-nesting birds in northwestern Washington.
J. Wildl. Manage. 49:255-263 1985

KEYWORDS: cavity nesting birds;habitat selection;forest management;snag management;timber harvest;selection cuts;clearcutting;management recommendations;coniferous forest;Washington USA

ABSTRACT: Population characteristics and nest-site preferences of 11 species of cavity-nesting birds were studied in the Olympic National Forest (ONF) of northwestern Washington in the spring and summer of 1979-1980. We characterized breeding populations in four different forest successional stages where either high or low densities of snags occurred. Species richness (N=13 vs. N=9), densities (P<0.01), and diversities (p<0.01) of cavity-nesting birds increased with increasing snag densities. Active cavity-nests were five times more numerous on the 1980 plots (Snag Plots) than the 1979 plots (Clean Plots). Snag densities on the Snag Plots varied from 13.8/ha in a clear-cut to 97.1/ha in 25-50 year old second-growth stand. Clean Plots contained from 0.5 snags/ha in a clear-cut to 37.3 in old-growth. Hairy woodpeckers, a primary cavity-nester, selected western hemlock snags for nest sites. In contrast, broken-topped Douglas-fir snags were preferred by secondary cavity-nesters. The average diameter at breast height (dbh) for active nest trees was substantially greater than the mean dbh for sampled snags in the ONF. Snags appear to be a limiting factor for breeding cavity-nesting bird populations. We discuss management recommendations for cavity-nesting birds in the ONF.

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Zeedyk, W.D.; Evans, K.E.
Silviculture options and habitat values in deciduous forests.
Pp. 115-127 in: D.R. Smith, tech. coord. Proc. of the symposium on management of forest and range habitats for nongame birds. USDA For. Serv. Gen. Tech. Rept. WO-1. 1975

KEYWORDS: avian ecology;avian diversity;bird-habitat relationships;silviculture;even-aged management;uneven-aged management;culling;snags;regeneration;fire;management implications

ABSTRACT: The avifauna diversity provides a challenging and unique opportunity to coordinate timber and wildlife management. Management options should consider three concepts: (1) structural characteristics of the vegetation greatly influence avifauna composition; (2) birds (of different species) occur in nearly every landscape condition; and (3) species differ in their habitat specificity. We have discussed the options of exploitation, even-aged management, uneven-aged management, and preservation. Future silvicultural systems should consider the broad forest perspective, provide for species with specific habitat requirements.

SUBSECTION INDEX

SUBSECTION INDEX
ECOLOGY AND LIFE HISTORY

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Ahlen	I.		1976	6
Airola	D.A.	Barrett, R.H.	1985	9
Alatalo	R.V.		1982	10
Allen	A.W.		1987	11
Ambrose	R.E.		1975	12
Anderson	R.J.		1985	15
Anderson	S.H.		1979	17
Anderson	S.H.		1980	18
Anderson	S.H.	Robbins, C.S.	1981	21
Anderson	S.H.	Shugart, H.H.	1974	22
Anderson	S.H.	Shugart, H.H. Jr.;Smith, T.M.	1979	23
Apfelbaum	S.	Haney, A.	1981	24
Askins	R.A.	Philbrick, M.J.	1987	26
Askins	R.A.	Philbrick, M.J.;Sugeno, D.S.	1987	27
Back	G.N.		1982	30
Balda	R.P.		1975	33
Balen	J.H. van	Booy, C.J.H.;Francker, J.A. van;Osieck, E.R.	1982	35
Bart	J.		1979	39
Beals	E.W.		1960	41
Beebe	S.B.		1974	44
Bendell	J.F.		1974	48
Best	L.B.	Stauffer, D.F.;Geier, A.R.	1979	50
Blackford	J.L.		1955	57
Blake	J.G.		1983	60
Blake	J.G.	Karr, J.R.	1984	61
Blake	J.G.	Karr, J.R.	1987	62
Blood	D.A.	Anweiler, G.G.	1984	64
Bock	C.E.	Bock, J.H.	1983	65
Bock	C.E.	Lynch, J.F.	1970	66
Bowman	G.B.	Harris, L.D.	1980	70
Brawn	J.D.	Elder, W.H.;Evans, K.E.	1982	72
Brawn	J.D.	Tannenbaum, B.;Evans, K.E.	1984	73
Brittingham	M.C.	Temple, S.A.	1983	74
Bruns	H.		1960	76
Brush	T.	Anderson, B.W.;Ohmart, R.D.	1983	78
Bryant	A.A.		1986	79
Buckner	C.H.		1975	80
Buckner	C.H.	McLeod, B.B.	1975	90
Buckner	C.H.	McLeod, B.B.	1977	82
Buckner	C.H.	McLeod, B.B.;Gochnaver, T.A.	1974	83
Buckner	C.H.	McLeod, B.B.;Kingsbury, P.D.	1975	84
Buckner	C.H.	McLeod, B.B.;Kingsbury, P.D.	1975	86
Buckner	C.H.	McLeod, B.B.;Kingsbury, P.D.	1975	87
Buckner	C.H.	McLeod, B.B.;Kingsbury, P.D.	1975	85
Buckner	C.H.	McLeod, B.B.;Lidstone, R.G.	1976	88
Buckner	C.H.	McLeod, B.B.;Ray, D.G.H.	1973	89
Buckner	C.H.	Sarazin, R.	1975	90
Bull	E.L.		1978	91
Bull	E.L.		1983	92
Bull	E.L.	Henjum, M.G.;Anderson, R.G.	1987	93
Bull	E.L.	Meslow, E.C.	1977	94
Bull	E.L.	Partridge, A.D.	1986	95
Bull	E.L.	Peterson, S.R.;Thomas, J.W.	1986	97
Bull	E.L.	Twombly, A.D.;Quigley, T.M.	1980	98
Bunnell	F.L.	Allaye-Chan, A.	1984	99

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Burke	M.		1983	102
Burr	R.M.	Jones, R.E.	1968	104
Capen	D.E.		1979	106
Carbyn	L.N.		1971	109
Carmichael	D.B. Jr.	Guynn, D.C., Jr.	1983	113
Carrow	J.R.,Jr.		1974	114
Chesko	G.G.	Gates, J.E.	1982	116
Cline	S.P.	Phillips, C.A.	1983	121
Conner	R.N.	Adkisson, C.S.	1974	125
Conner	R.N.	Adkisson, C.S.	1975	126
Conner	R.N.	Adkisson, C.S.	1976	127
Conner	R.N.	Crawford, H.S.	1974	128
Conner	R.N.	Dickson, J.G.;Locke, B.A.;Segelquist, C.A.	1983	130
Conner	R.N.	Hooper, R.G.;Crawford, H.S.;Mosby, H.S.	1975	132
Conner	R.N.	Locke, B.A.	1979	134
Conner	R.N.	Via, J.W.;Pather, I.D.	1979	138
Crawford	H.S.	Hooper, R.G.;Titterington, R.W.	1981	142
Crawford	H.S.	Jennings, D.T.	1986	143
Crawford	H.S.	Titterington, R.W.	1979	144
Crawford	H.S.	Titterington, R.W.;Jennings, D.T.	1983	145
Crockett	A.B.	Hanoley, P.L.	1978	146
Crouch	G.L.		1983	148
Cunningham	J.B.	Balda, R.P.;Gaud, W.S.	1980	149
Curtis	R.L.	Ripley, T.H.	1975	151
Davis	J.W.	Goodwin, G.A.;Ockenfels, R.A., tech. coord.	1983	152
Dawson	D.K.		1979	155
DeGraaf	R.M	Wentworth, J.M.	181	163
DeGraaf	R.M.		1978	158
DeGraaf	R.M.	Chadwick, N.L.	1987	161
DeGraaf	R.M.	Evans, K.E., eds.	1979	160
DeGraaf	R.M.	Shingo, A.L.	1985	162
DeGraaf	R.M., tech		1978	157
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DellaSala	D.A.		1986	165
DeLotelle	R.S.	Epting, R.J.	1988	166
Des Granges	J.L.		1980	167
DeWeese	L.R.	Henny, C.J.;Floyd, R.L.;Bobal. K.A.;Schultz, A.W.	1979	168
Dickson	J.G.		1978	171
Dickson	J.G.	Conner, R.N.;Fleet, R.R.;Kroll, J.C.;Jackson, J.A., e	1979	172
Dickson	J.G.	Segelquist, C.A.	1979	174
Diem	K.L.	Zeveloff, S.I.	1980	176
Dowden	P.B.	Joynes, H.A.;Carolin, V.M.	1953	178
Dunlavy	J.C.		1935	179
Edwards	M.G.		1978	181
Eidt	D.C.	Pearce, P.A.	1986	184
Engstrom	K.		1955	189
Erdelen	M.		1984	191
Erksine	A.J.	McLaren, W.D.	1972	195
Erskine	A.J.		1968	192
Erskine	A.J.		1977	193
Euler	D.L.	Thompson, D.Q.	1978	196
Evans	K.E.		1978	198
Evans	K.E.	Conner, N.	1979	199
Finley	R.B.		1965	202
Fischer	W.C.	McClelland, B.R.	1983	204
Flack	J.A.D.		1976	205
Forman	R.T.T.	Galli, A.E.;Leck, C.F.	1976	206
Forsman	E.D.	Meslow, E.C.;Strab, M.J.	1977	207
Fowle	C.D.		1965	208

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Fowle	C.D.		1972	209
Fowler	N.E.	Howe, R.W.	1987	210
Fox	R.	Rhea, B.	1989	211
Francis	J.	Lumbis, K.	1979	212
Franzreb	K.E.		1975	213
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Franzreb	K.E.		1978	215
Franzreb	K.E.		1983	216
Franzreb	K.E.	Ohmart, R.D.	1978	217
Freedman	B.	Beauchamp, C.;McLaren, I.A.;Tingley, S.I.	1981	218
Freemark	K.E.	Merriam, H.G.	1986	220
Frissell	S.		1984	221
Fuller	R.J.	Moreton, B.O.	1987	223
Galli	A.E.	Leck, C.F.;Forman, R.T.T.	1976	228
Gauthreaux	S.A. Jr.		1978	232
George	J.L	Mitchell, R.T.	1948	233
Gerell	R.		1988	234
Gill	J.D.	DeGraaf, R.M.;Thomas, J.W.	1974	238
Glowacinski	Z.		1975	239
Glowacinski	Z.	Weiner, J.	1983	242
Granholm	S.L.		1982	247
Grue	C.E.	Shipley, B.K.	1981	248
Gutierrez	R.J.		1985	253
Gutierrez	R.J.	Carey, B. (tech. eds)	1985	255
Gutierrez	R.T.	Decker, D.J.;Howard, R.A., Jr.;Lassoie, J.P.	1979	254
Hagar	D.C.		1960	258
Haila	U.	Jarvinen, O.;Vaisanen, R.A.	1980	259
Hale	J.B.	Gregg, L.E.	1976	261
Hall	G.A.		1984	263
Hamilton	R.B.	Noble, R.E.	1975	265
Hardin	K.I.	Evans, K.E.	1977	266
Harestad	A.S.	Keisker, D.G.	1989	267
Harris	J.		1983	270
Heinselman	M.L.		1973	276
Helle	P.		1985	277
Helle	P.		1987	278
Helle	P.	Fuller, R.J.	1988	279
Herrera	C.M.		1978	281
Herrera	C.M.		1978	280
Holling	C.S.		1988	284
Holmes	R.T.	Robinson, S.K.	1981	285
Holt	D.W.	Hillis, J.M.	1987	286
Hooven	E.F.		1969	291
Hopkins	R.B.	Cassel, J.F.;Bjugstad, A.J.	1986	292
Howe	R.W.		1984	295
Hunter	M.L. Jr.		1981	298
Jackson	J.A.		1970	302
Jackson	J.A.		1977	303
Jackson	J.A.	Jackson, D.J.J.	1986	304
Jackson	J.A.	Lennartz, M.K.;Hooper, R.G.	1979	305
James	F.C.		1971	306
James	F.C.	Rathbun, S.	1981	308
James	F.C.	Wamer, N.O.	1982	310
Johnson	A.S.	Landers, J.L.	1982	313
Johnston	D.W.		1974	320
Johnston	D.W.		1975	321
Johnston	D.W.	Odum, E.P.	1956	322
Karr	J.R.		1968	324
Karr	J.R.		1976	325

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Keith	J.O.	Hunt, E.	1969	330
Kendeigh	S.C.		1948	334
Kessler	W.B.	Kogut, T.E.	1985	338
Knight	F.R.		1958	343
Komarek	E.V. Jr.		1969	344
Koonz	W.H.		1988	346
Koplin	J.R.		1969	348
Koplin	J.R.	Baldwin, P.H.	1970	350
Kricher	J.C.	William, E.D., Jr.	1986	351
Lack	D.		1933	353
Landers	P.B.	MacMahon, J.A.	1980	357
Lanier	J.W.		1986	358
Larsen	J.A.		1980	359
Lautenschlager	R.A.		1986	361
Lawrence	G.E.		1966	362
Lay	D.W.		1938	363
Lennartz	M.	Lancia, R.	1989	365
Lorenberg	E.I.		1964	367
Lovejoy	T.E.		1983	369
Lovejoy	T.E.	Bierregaard, R.O.;Rankin, J.M.;Schubart, H.O.R.	1983	370
Lowe	P.O.	Ffolliott, P.F.;Dieterich, J.H.;Patton, D.	1978	373
Lynch	J.F.	Whigham, K.F.	1984	375
Lynch	J.F.	Whitcomb, R.F.	1978	376
MacArthur	R.H.		1958	378
MacArthur	R.H.	MacArthur, J. W.	1961	382
MacArthur	R.H.	MacArthur, J.W.;Preer, J.	1962	383
MacKenzie	D.I.	Sealy, S.G.;Sutherland, G.D.	1982	387
MacKenzie	J.M.D.		1952	388
MacLellan	C.R.		1959	389
Mannan	R.W.		1980	393
Mannan	R.W.		1982	394
Mannan	R.W.	Meslow, E.C.	1984	396
Mannan	R.W.	Meslow, E.C.;Wight, H.M.	1980	397
Manuwal	D.A.	Munger, G.	1978	398
Marcot	B.G.		1983	399
Martin	N.D.		1960	403
Martin	T.E.		1980	404
Martin	T.E.		1988	405
Martin	T.E.	Karr, J.R.	1986	406
Marzluff	J.M.	Lyon, L.J.	1983	407
Mathisen	J.E.		1968	410
McCelland	B.R.		1980	419
McCelland	B.R.	Frissel, S.S.;Fischer, W.C.;Halvorson, C.H.	1979	421
McCelland	B.R.	Frissell, S.S.	1975	420
McClelland	B.R.		1977	418
McCluskey	D.C.	Thomas, J.W.;Meslow, E.C.	1977	422
McComb	W.C.	Bonney. S.A.;Sheffield, R.M.;Cost, N.D.	1986	424
McCoy	E.D.		1982	428
McGarigal	K.	Fraser, J.D.	1984	429
McLellan	C.H.	Dobson, A.P.;Wilcove, D.S.;Lynch, J.F.	1986	430
Medin	D.E.		1985	433
Medin	D.E.		1985	434
Medin	D.E.	Booth, G.D.	1989	435
Meslow	E.C.	Wight, H.M.	1975	439
Micheal	E.D.	Thornburgh, P.I.	1971	441
Miller	E.	Miller, D.R.	1980	442
Monkkonen	M.	Helle, P.	1987	446
Morely	A.		1940	449
Morrison	M.L.		1981	454

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Morrison	M.L.		1982	455
Morrison	M.L.	Melow, E.C.	1983	458
Morrison	M.L.	Meslow, E.C.	1984	459
Morrison	M.L.	Raphael, M.G.;Heald, R.C.	1983	461
Morrison	M.L.	With, K.A.;Timossi, I.C.	1986	463
Moulding	J.D.		1976	469
Myers	C.A.	Morris, M.J.	1975	471
Myiberget	J.		1977	444
Nero	R.W.	Clark, R.J.;Knaptor, R.J.;Hamre, R.H. eds	1987	475
Niemi	G.J.	Hanowski, J.M.	1984	478
Niemi	G.J.	Pfannmuller, L.	1979	479
Noble	R.E.	Hamilton, R.B.	1976	482
Noon	B.R.	Able, K.P.	1978	484
Noon	B.R.	Bingman, V.P.;Noon, J.P.	1979	485
Otvos	I.S.		1979	493
Pearce	P.A.	Garrity, N.R.	1981	497
Pearce	P.A.	Peakall, D.B.;Erskin, A.J.	1976	499
Pearce	P.A.	Peakall, D.B.;Erskine, A.J.	1979	498
Pearson	D.L.		1975	500
Peterson	A.		1986	503
Peterson	B.	Gauthier, G.	1985	504
Peterson	E.B.	Peterson, N.M.	1983	505
Peterson	S.R.		1975	506
Pinowski	B.C.		1976	510
Plunkett	R.L.		1979	511
Probst	J.R.		1979	512
Probst	J.R.		1988	513
Raphael	M.G		1980	517
Raphael	M.G.		1984	519
Raphael	M.G.	White, M.	1984	521
Repenning	R.W.	Labisky, R.F.	1985	526
Reynolds	R.T.		1983	527
Robbins	C.S.		1979	535
Robbins	C.S.	Dawson, D.K.;Dowell, B.A.	1989	536
Robbins	C.S.	Erskine, A.J.	1975	537
Roe	N.A.		1974	539
Roppe	J.A.	Hein, D.	1978	541
Runde	D.E.	Capen, D.E.	1987	548
Salt	G.W.		1957	550
Samson	F.B.		1980	552
Sanderson	H.R.Bull,	Edgerton, P.J.	1980	554
Schroeder	R.L.		1982	560
Schroeder	R.L.		1982	563
Schroeder	R.L.		1983	561
Schroeder	R.L.		1983	562
Scott	V.E.	Evans, K.E.;Patton, D.R.;Stone, C.P.	1977	573
Scott	V.E.	Oldemeyer, J.L.	1983	575
Scott	V.E.	Whelan, J.A.;Alexander, R.R.	1978	576
Scott	V.E.	Whelan, J.A.;Svoboda, P.L.	1980	577
Scoullar	K.A.		1980	579
Servos	M.C.		1987	582
Shaffer	M.L.		1985	584
Shook	R.S.	Baldwin, P.H.	1970	587
Shugart	H.H.	Anderson, S.H.;Strand, R.H.	1975	589
Shugart	H.H.	James, D.	1973	591
Shugart	H.H.	Smith, T.M.;Kitchings, J.T.;Kroodsma, R.L.	1978	592
Sloan	N.F.	Coppel, H.C.	1968	597
Smith	D.R., tech		1975	600
Smith	K.G.		1980	602

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Snyder	D.P.		1950	605
Sousa	P.J.		1982	606
Sousa	P.J.		1983	607
Sousa	P.J.		1983	608
Sousa	P.J.		1987	609
Spires	S.	Bendell, J.F.	1982	610
Sprunt	A. IV		1975	611
Stauffer	D.F.	Best, L.B.	1980	613
Stauffer	D.F.	Best, L.B.	1982	614
Stelfox	J.G.		1984	615
Stevens	L.E.	Brown, B.T.;Simpson, J.M.;Johnson, R.R.	1977	616
Swallow	S.K.		1986	622
Taylor	C.M.	Taylor, W.E.	1979	630
Taylor	D.L.	Barmore, W.J. Jr.	1980	634
Telfer	E.S.		1976	636
Temple	S.A.	Maseman, M.J.;Ambuel, B.	1979	641
Theberge	J.B.		1976	642
Thomas	J.W.	Anderson, R.G.;Maser, C.;Bull, E.L.	1979	644
Thomas	J.W.	Crouch, G.L.;Bumstead, R.S.;Bryant, L.D.	1975	645
Thomas	J.W.	DeGraaf, R.M.;Mawson, J.C.	1977	646
Thomas	J.W.	McCluskey, D.C.	1974	648
Thomas	J.W.	Miller, R.;Maser, C.;Anderson, R.;Carter, B.	1978	651
Thomas	J.W.	Miller, R.J.;Maser, C.;Anderson, R.G.;Carter, B.E.	1979	650
Tilghman	N.G.		1987	654
Todd	C.S.	Owen, R.B., Jr.	1986	658
Trial	H., Jr.		1986	660
Tubbs	A.A.		1980	661
Varty	J.W.		1978	664
Verner	J.		1975	667
Wagner	J.L.		1981	669
Webb	W.L.		1977	673
Webb	W.L.	Behrend, D.F.;Sarworn, B.	1977	674
Welsh	D.A.		1988	679
West	G.C.	DeWolfe, B.B.	1974	681
Westworth	D.A.	Brusnyk, L.M.;Burns, G.R.	1984	682
Wetmore	S.P.	Booth, B.	1886	683
Whitfield	D.W.A.	Gerrard, J.M.;Maher, W.J.;Davis, D.W.	1974	689
Wiens	J.A.		1975	692
Wiens	J.A.		1978	691
Wight	H.M.		1974	693
Wilcove	D.S.		1985	694
Wilcove	D.S.		1985	695
Wilcove	D.S.		1987	696
Williams	J.B.		1975	698
Willson	M.F.		1972	703
Winkler	D.W.	Dana, G.	1977	705
Winternitz	B.L.		1980	707
Wood	G.W.	Niles, L.J.;Hendrick, R.M.;Davis, J.R.;Grimes, T.L.	1985	710
Yahner	R.H.		1986	711
Yahner	R.H.		1987	712
Yahner	R.H.	Scott, D.P.	1988	713
Yamasaki	M.	Tubbs, C.	1986	714
Zarnowitz	J.E.	Manuwal, D.A.	1985	717

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STATUS/DISTRIBUTION/DIVERSITY/DENSITY

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Adams	M.W.	Edington,J.M.	1973	4
Ahlen	I.		1976	6
Airola	D.A.	Barrett, R.H.	1985	9
Alatalo	R.V.		1982	10
Ambrose	R.E.		1975	12
Ambuel	B.	Temple, S.A.	1983	13
Anderson	B.W.	Ohmart, R.D.;Rice, J.	1983	14
Anderson	S.H.		1979	16
Anderson	S.H.		1979	17
Anderson	S.H.	Mann, K.;Shugart, H.H., Jr.	1977	20
Anderson	S.H.	Robbins, C.S.	1981	21
Anderson	S.H.	Shugart, H.H. Jr.;Smith, T.M.	1979	23
Apfelbaum	S.	Haney, A.	1981	24
Askins	R.A.	Philbrick, M.J.	1987	26
Askins	R.A.	Philbrick, M.J.;Sugeno, D.S.	1987	27
Austin	D.D.	Perry, M.L.	1979	28
Back	G.N.		1979	29
Back	G.N.		1982	30
Balda	R.P.		1969	31
Balda	R.P.		1975	33
Balda	R.P.	Gaud, W.S.;Brawn, J.D.	1983	34
Bamford	R.		1985	36
Bamford	R.		1986	37
Batten	L.A.	Pomeroy, D.E.	1969	40
Beals	E.W.		1960	41
Beaver	D.L.		1976	43
Beebe	S.B.		1974	44
Beedy	E.C.		1981	45
Bendell	J.F.		1974	48
Bergstedt	B.	Niemi, G.J.	1974	49
Bilcke	G.		1984	52
Blackford	J.L.		1955	57
Blake	J.G.		1982	58
Blake	J.G.		1983	60
Blake	J.G.	Karr, J.R.	1984	61
Blake	J.G.	Karr, J.R.	1987	62
Blood	D.A.	Anweiler, G.G.	1984	64
Bock	C.E.	Lynch, J.F.	1970	66
Bock	C.E.	Raphael, M.;Bock, J.M.	1978	67
Boecklen	W.J.		1986	68
Bond	R.R.		1957	69
Brittingham	M.C.	Temple, S.A.	1983	74
Bruns	H.		1960	76
Brush	T.	Anderson, B.W.;Ohmart, R.D.	1983	78
Bunnell	F.L.	Allaye-Chan, A.	1984	99
Burr	R.M.		1969	103
Burr	R.M.	Jones, R.E.	1968	104
Capen	D.E.		1979	106
Capen	D.E.	Cooper, R.J.;DeGraaf, D.M.	1979	107
Carbyn	L.N.		1971	109
Casey	D.	Hein, D.	1983	115
Chasko	G.G.	Gates, J.E.	1982	116
Clark	K.	Euler, D.;Armstrong, E.	1983	118
Cline	S.P.	Phillips, C.A.	1983	121
Conner	R.N.	Adkisson, C.S.	1975	126

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Conner	R.N.	Dickson, J.G.;Locke, B.A.;Segelquist, C.A.	1983	130
Conner	R.N.	Via, J.W.;Pather, I.D.	1979	138
Crawford	H.S.	Hooper, R.G.;Titterington, R.W.	1981	142
Crawford	H.S.	Titterington, R.W.	1979	144
Crockett	A.B.	Hanoley, P.L.	1978	146
Cross	C.W.		1963	147
Cunningham	J.B.	Balda, R.P.;Gaud, W.S.	1980	149
Currie	F.A.	Bamford, R.	1982	150
Davis	J.W.	Goodwin, G.A.;Ockenfels, R.A., tech. coord.	1983	152
Dawson	D.K.		1979	155
DeByle	N.V.		1981	156
DeGraaf	R.M	Wentworth, J.M.	70	163
DeGraaf	R.M.	Chadwick, N.L.	1987	161
DeGraaf	R.M.	Evans, K.E., eds.	1979	160
DeGraaf	R.M., tech		1978	157
DeGraaf	R.M., tech		1980	159
DellaSala	D.A.		1986	165
Des Granges	J.L.		1980	167
DeWeese	L.R.	Henny, C.J.;Floyd, R.L.;Bobal. K.A.;Schultz, A.W.	1979	168
Diamond	A.W.		1986	170
Dickson	J.G.		1978	171
Dickson	J.G.	Conner, R.N.;Fleet, R.R.;Kroll, J.C.;Jackson, J.A., eds.	1979	172
Dickson	J.G.	Segelquist, C.A.	1979	174
Edgerton	P.J.	Thomas, J.W.	1978	180
Edwards	M.G.		1978	181
Emlen	J.T.		1970	185
Emlen	J.T.		1971	186
Engstrom	K.		1955	189
Erdelen	M.		1984	191
Erskine	A.J.		1968	192
Erskine	A.J.		1977	193
Erskine	A.J.		1978	194
Euler	D.L.	Thompson, D.Q.	1978	196
Evans	K.E.		1978	197
Evans	K.E.		1978	198
Evans	K.E.	Conner, N.	1979	199
Finney	G.H.	Cadieux, P.;Silieff, E.	1980	203
Fischer	W.C.	McClelland, B.R.	1983	204
Flack	J.A.D.		1976	205
Forman	R.T.T.	Galli, A.E.;Leck, C.F.	1976	206
Forsman	E.D.	Meslow, E.C.;Strab, M.J.	1977	207
Fowler	N.E.	Howe, R.W.	1987	210
Francis	J.	Lumbis, K.	1979	212
Franzreb	K.E.		1975	213
Franzreb	K.E.		1977	214
Franzreb	K.E.	Ohmart, R.D.	1978	217
Freedman	B.	Beauchamp, C.;McLaren, I.A.;Tingley, S.I.	1981	218
Freedman	B.	Morgan, K.;Crowell, M.;Beauchamp, C.;Green, A.	1982	219
Freemark	K.E.	Merriam, H.G.	1986	220
Fry	K.		1982	222
Fuller	R.J.	Moreton, B.O.	1987	223
Gage	S.H.	Miller, C.A.	1978	224
Gauthreaux	S.A. Jr.		1978	232
Gerell	R.		1988	234
Glowacinski	Z.		1975	239
Glowacinski	Z.		1979	240
Glowacinski	Z.	Jarvinen, O.	1975	241
Glowacinski	Z.	Weiner, J.	1983	242
Granholm	S.L.		1982	247

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Gutierrez	R.J.		1985	253
Gutierrez	R.J.	Carey, B. (tech. eds)	1985	255
Gutierrez	R.T.	Decker, D.J.;Howard, R.A., Jr.;Lassoie, J.P.	1979	254
Hagar	D.C.		1960	258
Haila	U.	Jarvinen, O.;Vaisanen, R.A.	1980	259
Haila	Y.		1986	260
Hale	J.B.	Gregg, L.E.	1976	261
Hall	G.A.		1984	263
Hamilton	R.B.	Noble, R.E.	1975	265
Hardin	K.I.	Evans, K.E.	1977	266
Harestad	A.S.	Keisker, D.G.	1989	267
Helle	P.		1985	277
Helle	P.		1987	278
Helle	P.	Fuller, R.J.	1988	279
Herrera	C.M.		1978	281
Herrera	C.M.		1978	280
Holling	C.S.		1988	284
Hooper	R.G.		1978	288
Hooper	R.G.	Crawford, H.S.;Harlow, R.F.	1973	290
Hopkins	R.B.	Cassel, J.F.;Bjugstad, A.J.	1986	292
Horton	S.P.	Mannan, R.W.	1988	293
Howe	R.W.		1984	295
Hunter	M.L. Jr.		1981	298
James	F.C.	Rathbun, S.	1981	308
James	F.C.	Wamer, N.O.	1982	310
Johnson	A.S.	Landers, J.L.	1982	313
Johnson	N.K.		1975	315
Johnston	D.W.		1970	319
Johnston	D.W.	Odum, E.P.	1956	322
Jones	P.H.		1972	323
Karr	J.R.		1968	324
Karr	J.R.		1976	325
Karr	J.R.	Roth, R.R.	1971	326
Kelsall	J.P.	Telfer, E.S.;Wright, T.D.	1977	331
Kendeigh	S.C.		1946	332
Kendeigh	S.C.		1948	334
Kerlinger	P.	Doremus, C.	1981	335
Kessler	W.B.		1979	336
Kessler	W.B.		1980	337
Kilgore	B.M.		1971	340
Knight	F.R.		1958	343
Koplin	J.R.		1972	349
Kricher	J.C.	William, E.D., Jr.	1986	351
Kroodsma	R.L.		1982	352
Lack	D.		1939	354
Lack	D.	Lack, E.	1951	355
Landers	P.B.	MacMahon, J.A.	1980	357
Larsen	J.A.		1980	359
Lawrence	G.E.		1966	362
Lay	D.W.		1938	363
Lennartz	M.	Lancia, R.	1989	365
Lorenberg	E.I.		1964	367
Lovejoy	T.E.		1972	368
Lovejoy	T.E.	Bierregaard, R.O.;Rankin, J.M.;Schubart, H.O.R.	1983	370
Lovejoy	T.E.	Rankin, J.M.;Bierregaard, R.D.;Brown, K.S.;Emmons, L.H.;V	1984	371
Lowe	P.O.	Ffolliott, P.F.;Dieterich, J.H.;Patton, D.	1978	373
Lynch	J.F.	Whigham, K.F.	1984	375
Lynch	J.F.	Whitcomb, R.F.	1978	376
MacArthur	R.H.		1958	378

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
MacArthur	R.H.		1959	379
MacArthur	R.H.		1964	380
MacArthur	R.H.	MacArthur, J. W.	1961	382
MacArthur	R.H.	MacArthur, J.W.;Preer, J.	1962	383
MacArthur	R.H.	Recher, H.;Cody, M.	1966	384
MacClintock	L.	Whitcomb, R.F.;Whitcomb, B.L.	1977	385
MacDonald	J.E.		1966	386
MacLellan	C.R.		1959	389
Mannan	R.W.		1980	393
Mannan	R.W.		1982	394
Mannan	R.W.	Meslow, E.C.	1981	395
Mannan	R.W.	Meslow, E.C.	1984	396
Mannan	R.W.	Meslow, E.C.;Wight, H.M.	1980	397
Manuwal	D.A.	Munger, G.	1978	398
Marcot	B.G.		1983	399
Martin	N.D.		1960	403
Martin	T.E.		1980	404
Martin	T.E.		1988	405
Marzluff	J.M.	Lyon, L.J.	1983	407
Maurer	B.A.	McArthur, L.B.;Whitmore, R.C.	1981	414
McCelland	B.R.		1980	419
McCelland	B.R.	Frissel, S.S.;Fischer, W.C.;Halvorson, C.H.	1979	421
McComb	W.C.	Rumsey, R.L.	1983	427
McCoy	E.D.		1982	428
McLellan	C.H.	Dobson, A.P.;Wilcove, D.S.;Lynch, J.F.	1986	430
McNeil	R.		1982	431
Medin	D.E.		1985	433
Medin	D.E.		1985	434
Medin	D.E.	Booth, G.D.	1989	435
Meslow	E.C.	Wight, H.M.	1975	439
Meyers	J.M.	Johnson, A.S.	1978	440
Micheal	E.D.	Thornburgh, P.I.	1971	441
Monkkonen	M.	Helle, P.	1987	446
Monson	G.		1941	447
Moore	N.W.	Hooper, M.D.	1975	448
Morgan	K.	Freedman, B.	1986	451
Morgan	K.H.	Wetmore, S.P.;Smith, G.E.J.;Keller, R.A.	1989	452
Morrison	M.L.		1981	454
Morrison	M.L.		1982	455
Morrison	M.L.	Meslow, E.C.	1983	456
Morrison	M.L.	Meslow, E.C.	1983	457
Morrison	M.L.	Meslow, E.C.	1984	460
Morrison	M.L.	Meslow, E.C.	1984	459
Morrison	M.L.	Timossi, I.C.;With, K.A.	1987	462
Morrison	M.L.	With, K.A.;Timossi, I.C.	1986	463
Morse	D.H.		1977	464
Moss	D.		1978	467
Moss	D.		1978	466
Moss	D.	Taylor, P.N.;Easterbee, N.	1979	468
Nero	R.W.	Clark, R.J.;Knaptor, R.J.;Hamre, R.H. eds	1987	475
Newton	I.		1983	476
Niemi	G.J.	Hanowski, J.M.	1984	478
Niemi	G.J.	Pfannmuller, L.	1979	479
Nilsson	S.G.		1977	480
Nilsson	S.G.		1979	481
Noble	R.E.	Hamilton, R.B.	1976	482
Noon	B.R.	Able, K.P.	1978	484
Noon	B.R.	Bingman, V.P.;Noon, J.P.	1979	485
O'Meura	T.E.	Haufler, J.B.;Stelter, L.H.;Nagy, J.G.	1981	487

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Odum	E.P.		1950	488
Oelke	H.		1967	489
Opdam	P.	Schotman, A.	1986	491
Patrice	R.		1987	495
Pearson	D.L.		1975	500
Perkins	C.J.		1973	501
Peterson	E.B.	Peterson, N.M.	1983	505
Peterson	S.R.		1975	506
Petit	D.R.	Petit, K.E.;Grubb, T.C., Jr.	1985	507
Probst	J.R.		1979	512
Ralph	C.J.	Scott, J.M., eds.	1981	514
Ramsden	D.J.	Lyon, L.J.;Halvorson, G.L.	1979	515
Raphael	M.G		1980	517
Raphael	M.G.		1983	518
Raphael	M.G.		1984	519
Raphael	M.G.	White, M.	1984	521
Recher	H.		1969	525
Repenning	R.W.	Labisky, R.F.	1985	526
Rice	J.	Anderson, B.W.;Ohmart, R.D.	1984	530
Robbins	C.S.		1978	534
Robbins	C.S.		1979	535
Robbins	C.S.	Dawson, D.K.;Dowell, B.A.	1989	536
Robbins	C.S.	Erskine, A.J.	1975	537
Roble	R.J.	Browning, N.G.	1981	538
Roe	N.A.		1974	539
Roppe	J.A.	Hein, D.	1978	541
Roth	R.R.		1976	544
Rov	N.		1975	545
Salt	G.W.		1957	550
Sanders	C.J.		1970	553
Sanderson	H.R.Bull,	Edgerton, P.J.	1980	554
Savidge	J.A.		1978	556
Schwab	F.E.		1979	565
Scott	V.E.		1979	567
Scott	V.E.	Crouch, G.L.	1987	568
Scott	V.E.	Crouch, G.L.	1988	571
Scott	V.E.	Crouch, G.L.	1988	569
Scott	V.E.	Crouch, G.L.	1988	570
Scott	V.E.	Crouch, G.L.;Whelan, J.A.	1982	572
Scott	V.E.	Evans, K.E.;Patton, D.R.;Stone, C.P.	1977	573
Scott	V.E.	Gottfried, G.J.	1983	574
Scott	V.E.	Oldemeyer, J.L.	1983	575
Scott	V.E.	Whelan, J.A.;Svoboda, P.L.	1980	577
Scoullar	K.A.		1980	579
Sedgewick	J.A.	Knopf, F.L.	1986	580
Servos	M.C.		1987	582
Shugart	H.H.	Anderson, S.H.;Strand, R.H.	1975	589
Shugart	H.H.	Dueser, R.D.;Anderson, S.H.	1974	590
Shugart	H.H.	James, D.	1973	591
Shugart	H.H.	Smith, T.M.;Kitchings, J.T.;Kroodsma, R.L.	1978	592
Silovsky	G.D.	Pinto, C.	1974	595
Slagsvold	T.		1977	596
Smith	D.R., tech		1975	600
Smith	K.G.		1980	602
Smith	T.M.	Shugart, H.H.;West, D.C.		603
Snyder	D.P.		1950	605
Sprunt	A. IV		1975	611
Stauffer	D.F.	Best, L.B.	1980	613
Stelfox	J.G.		1984	615

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Stevens	L.E.	Brown, B.T.;Simpson, J.M.;Johnson, R.R.	1977	616
Stewart	R.E.	Aldrich, J.W.	1949	617
Strelke	W.K.	Dickson, J.G.	1980	619
Swift	B.L.	Larson, J.S.;DeGraff, R.M.	1984	623
Szaro	R.C.		1980	624
Szaro	R.C.	Balda, R.P.	1979	625
Szaro	R.C.	Balda, R.P.	1982	626
Szaro	R.C.	Balda, R.P.	1986	627
Takekawa	J.Y.	Garton, E.O.;Lanelier, L.A.	1982	629
Taylor	C.M.	Taylor, W.E.	1979	630
Taylor	D.L.		1973	632
Taylor	D.L.		1979	633
Taylor	D.L.	Barmore, W.J. Jr.	1980	634
Telfer	E.S.		1977	637
Telfer	E.S.		1977	639
Temple	S.A.	Maseman, M.J.;Ambuel, B.	1979	641
Theberge	J.B.		1976	642
Tilghman	N.G.		1987	654
Titterington	R.W.	Crawford, H.S.;Burgason, B.N.	1979	656
Todd	C.S.	Owen, R.B., Jr.	1986	658
Tramer	E.J.		1969	659
Tubbs	A.A.		1980	661
Verner	J.		1975	667
Webb	W.L.		1977	673
Webb	W.L.	Behrend, D.F.;Sarworn, B.	1977	674
Welsh	D.A.		1981	676
Welsh	D.A.		1983	677
Welsh	D.A.	Fillman, D.R.	1980	680
West	G.C.	DeWolfe, B.B.	1974	681
Westworth	D.A.	Brusnyk, L.M.;Burns, G.R.	1984	682
Wetmore	S.P	Keller, R.A.;Smith, G.E.S.	1985	684
Wetmore	S.P.	Booth, B.	1886	683
Whitcomb	B.L.	Whitcomb, R.F.;Bystrak, D.	1977	685
Wiens	J.A.		1975	692
Wiens	J.A.		1978	691
Wight	H.M.		1974	693
Wilcove	D.S.		1985	694
Wilcove	D.S.		1985	695
Wilcove	D.S.	Terborgh, J.W.	1984	697
Williamson	K.		1970	700
Williamson	K.		1972	701
Willson	M.F.		1972	703
Willson	M.F.		1976	704
Winkler	D.W.	Dana, G.	1977	705
Winternitz	B.L.		1976	706
Winternitz	B.L.		1980	707
Yahner	R.H.		1986	711
Yahner	R.H.		1987	712
Yahner	R.H.	Scott, D.P.	1988	713
Yeager	L.E.		1955	715
Zarnowitz	J.E.	Manuwal, D.A.	1985	717
Zeedyk	W.D.	Evans, K.E.	1975	718

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BIOGEOGRAPHY

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD N
Ambuel	B.	Temple, S.A.	1983	13
Askins	R.A.	Philbrick, M.J.	1987	26
Blake	J.G.		1983	60
Blake	J.G.	Karr, J.R.	1984	61
Diamond	A.W.		1986	170
Diem	K.L.	Zeveloff, S.I.	1980	176
Erskine	A.J.		1977	193
Fischer	W.C.	McClelland, B.R.	1983	204
Flack	J.A.D.		1976	205
Forman	R.T.T.	Galli, A.E.;Leck, C.F.	1976	206
Fowler	N.E.	Howe, R.W.	1987	210
Freemark	K.E.	Merriam, H.G.	1986	220
Galli	A.E.	Leck, C.F.;Forman, R.T.T.	1976	228
Haila	U.	Jarvinen, O.;Vaisanen, R.A.	1980	259
Hardin	K.I.	Evans, K.E.	1977	266
Helle	P.		1987	278
Helle	P.	Fuller, R.J.	1988	279
Herrera	C.M.		1978	281
Herrera	C.M.		1978	280
Howe	R.W.		1984	295
Karr	J.R.		1976	325
Lynch	J.F.	Whigham, K.F.	1984	375
Lynch	J.F.	Whitcomb, R.F.	1978	376
MacArthur	R.H.		1959	379
Martin	T.E.		1980	404
McCoy	E.D.		1982	428
McNeil	R.		1982	431
Morse	D.H.		1977	464
Newton	I.		1983	476
Patrice	R.		1987	495
Probst	J.R.		1988	513
Robbins	C.S.	Dawson, D.K.;Dowell, B.A.	1989	536
Robbins	C.S.	Erskine, A.J.	1975	537
Samson	F.B.		1980	552
Snyder	D.P.		1950	605
Whitcomb	B.L.	Whitcomb, R.F.;Bystrak, D.	1977	685
Wiens	J.A.		1975	692
Wilcove	D.S.		1985	694
Willson	M.F.		1976	704

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AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD N
Anderson	S.H.	Robbins, C.S.	1981	21
Askins	R.A.	Philbrick, M.J.;Sugeno, D.S.	1987	27
Blake	J.G.		1983	59
Blake	J.G.	Karr, J.R.	1984	61
Boecklen	W.J.		1986	68
Boecklen	W.J.		1986	68
Bryant	A.A.		1986	79
DeLotelle	R.S.	Epting, R.J.	1988	166
Evans	K.E.		1978	197
Field	R.	Williams, B.K.	1985	201
Forman	R.T.T.	Galli, A.E.;Leck, C.F.	1976	206
Fowler	N.E.	Howe, R.W.	1987	210
Freemark	K.E.	Merriam, H.G.	1986	220
Gotfryd	A.	Hansell, R.I.C.	1986	244
Haila	U.	Jarvinen, O.;Vaisanen, R.A.	1980	259
Haila	Y.		1986	260
Hale	J.B.	Gregg, L.E.	1976	261
Hall	G.A.		1984	263
Harris	J.		1983	270
Helle	P.	Fuller, R.J.	1988	279
Hooper	R.G.	Crawford, H.S.	1969	289
Johnson	A.S.	Landers, J.L.	1982	313
Kessler	W.B.		1980	337
Lennartz	M.	Lancia, R.	1989	365
Lovejoy	T.E.	Bierregaard, R.O.;Rankin, J.M.;Schubart, H.O.R.	1983	370
Lynch	J.F.	Whitcomb, R.F.	1978	376
Mannan	R.W.		1982	394
McLellan	C.H.	Dobson, A.P.;Wilcove, D.S.;Lynch, J.F.	1986	430
Moore	N.W.	Hooper, M.D.	1975	448
Noon	B.R.	Bingman, V.P.;Noon, J.P.	1979	485
Probst	J.R.		1988	513
Robbins	C.S.		1979	535
Samson	F.B.		1980	552
Thomas	J.W.	Ruggiero, L.F.;Mannan, R.W.;Schoen, J.W.;Lancia, R.	1988	652
Verner	J.		1981	666
Welsh	D.A.		1983	677

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AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Adams	M.W.	Edington,J.M.	1973	4
Ahlen	I.		1976	6
Ahlgren	I.F.	Ahlgren, C.E.	1960	7
Airola	D.A.	Barrett, R.H.	1985	9
Alatalo	R.V.		1982	10
Allen	A.W.		1987	11
Ambrose	R.E.		1975	12
Ambuel	B.	Temple, S.A.	1983	13
Anderson	B.W.	Ohmart, R.D.;Rice, J.	1983	14
Anderson	R.J.		1985	15
Anderson	S.H.		1979	16
Anderson	S.H.		1979	17
Anderson	S.H.		1980	18
Anderson	S.H.		1981	19
Anderson	S.H.	Mann, K.;Shugart, H.H., Jr.	1977	20
Anderson	S.H.	Robbins, C.S.	1981	21
Anderson	S.H.	Shugart, H.H.	1974	22
Anderson	S.H.	Shugart, H.H. Jr.;Smith, T.M.	1979	23
Anonymous			0	1
Apfelbaum	S.	Haney, A.	1981	24
Arbuckle	J.		1986	25
Askins	R.A.	Philbrick, M.J.	1987	26
Askins	R.A.	Philbrick, M.J.;Sugeno, D.S.	1987	27
Austin	D.D.	Perry, M.L.	1979	28
Back	G.N.		1979	29
Back	G.N.		1982	30
Balda	R.P.		1969	31
Balda	R.P.		1975	33
Balda	R.P.	Gaud, W.S.;Brawn, J.D.	1983	34
Balen	J.H. van	Booy, C.J.H.;Francker, J.A. van;Osieck, E.R.	1982	35
Bamford	R.		1986	37
Batten	L.A.	Pomeroy, D.E.	1969	40
Beals	E.W.		1960	41
Beaver	D.L.		1976	43
Beedy	E.C.		1981	45
Bendell	J.F.		1974	48
Bergstedt	B.	Niemi, G.J.	1974	49
Best	L.B.	Stauffer, D.F.;Geier, A.R.	1979	50
Bilcke	G.		1984	52
Bissonette	J.A., ed.		1986	55
Blake	J.G.		1982	58
Blake	J.G.		1983	60
Blake	J.G.		1983	59
Blake	J.G.	Karr, J.R.	1984	61
Blake	J.G.	Karr, J.R.	1987	62
Blood	D.A.	Anweiler, G.G.	1984	64
Bock	C.E.	Bock, J.H.	1983	65
Bock	C.E.	Lynch, J.F.	1970	66
Bock	C.E.	Raphael, M.;Bock, J.H.	1978	67
Boecklen	W.J.		1986	68
Bond	R.R.		1957	69
Bowman	G.B.	Harris, L.D.	1980	70
Brawn	J.D.	Elder, W.H.;Evans, K.E.	1982	72
Brawn	J.D.	Tannenbaum, B.;Evans, K.E.	1984	73
Brittingham	M.C.	Temple, S.A.	1983	74

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Bruns	H.		1960	76
Brush	T.	Anderson, B.W.;Ohmart, R.D.	1983	78
Bryant	A.A.		1986	79
Bull	E.L.		1978	91
Bull	E.L.		1983	92
Bull	E.L.	Meslow, E.C.	1977	94
Bull	E.L.	Partridge, A.D.	1986	95
Bull	E.L.	Peterson, S.R.;Thomas, J.W.	1986	97
Bull	E.L.	Twombly, A.D.;Quigley, T.M.	1980	98
Bunnell	F.L.	Allaye-Chan, A.	1984	99
Bunnell	F.L.	Eastman, D.S.	1976	100
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Burke	M.		1983	102
Burr	R.M.		1969	103
Burr	R.M.	Jones, R.E.	1968	104
Capen	D.E.		1979	106
Capen	D.E.	Cooper, R.J.;DeGraaf, D.M.	1979	107
Capen	D.E.	Fenwick, J.W.;Inkley, D.B.;Boynton, A.C.	1986	108
Capen	D.E., ed.		1981	105
Carbyn	L.N.		1971	109
Carey	A.B.		1983	110
Carey	A.B.	Gill, J.D.	1983	111
Carmichael	D.B. Jr.	Guynn, D.C., Jr.	1983	113
Casey	D.	Hein, D.	1983	115
Chasko	G.G.	Gates, J.E.	1982	116
Cimon	N.		1983	117
Clark	K.	Euler, D.;Armstrong, E.	1983	118
Cline	S.P.	Berg, A.B.;Wight, H.M.	1980	120
Cline	S.P.	Phillips, C.A.	1983	121
Conner	R.N.		1978	122
Conner	R.N.	Adkisson, C.S.	1974	125
Conner	R.N.	Adkisson, C.S.	1975	126
Conner	R.N.	Adkisson, C.S.	1976	127
Conner	R.N.	Crawford, H.S.	1974	128
Conner	R.N.	Dickson, J.G.;Locke, B.A.	1981	129
Conner	R.N.	Dickson, J.G.;Locke, B.A.;Segelquist, C.A.	1983	130
Conner	R.N.	Dickson, J.G.;Williamson, J.H.	1983	131
Conner	R.N.	Hooper, R.G.;Crawford, H.S.;Mosby, H.S.	1975	132
Conner	R.N.	Locke, B.A.	1979	134
Conner	R.N.	Locke, B.A.	1982	135
Conner	R.N.	Miller, O.K. Jr.;Adkisson, C.S.	1976	136
Conner	R.N.	Via, J.W.;Pather, I.D.	1979	138
Connor	R.N.	O'Halloran, K.A.	1987	137
Corns	I.G.W.	La Roi, G.H.	1976	139
Cottam	G.	Curtis, J.T.	1956	140
Coulmbe	R.	Lemay, A.B.	1982	141
Crawford	H.S.	Hooper, R.G.;Titterington, R.W.	1981	142
Crawford	H.S.	Jennings, D.T.	1986	143
Crawford	H.S.	Titterington, R.W.	1979	144
Cross	C.W.		1963	147
Crouch	G.L.		1983	148
Cunningham	J.B.	Balda, R.P.;Gaud, W.S.	1980	149
Currie	F.A.	Bamford, R.	1982	150
Curtis	R.L.	Ripley, T.H.	1975	151
Davis	J.W.	Goodwin, G.A.;Ockenfels, R.A., tech. coord.	1983	152
Dawson	D.K.		1979	155
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DeGraaf	R.M	Wentworth, J.M.	0	163
DeGraaf	R.M.	Chadwick, N.L.	1987	161

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DeGraaf	R.M.	Evans, K.E., eds.	1979	160
DeGraaf	R.M.	Shingo, A.L.	1985	162
DeGraaf	R.M., tech		1978	157
DeGraaf	R.M., tech		1980	159
DellaSala	D.A.		1986	165
DeLotelle	R.S.	Epting, R.J.	1988	166
Des Granges	J.L.		1980	167
DeWeese	L.R.	Henny, C.J.;Floyd, R.L.;Bobal. K.A.;Schultz, A.W.	1979	168
Diamond	A.W.		1986	170
Dickson	J.G.		1978	171
Dickson	J.G.	Conner, R.N.;Fleet, R.R.;Kroll, J.C.;Jackson, J.A., eds.	1979	172
Dickson	J.G.	Conner, R.N.;Williamson, J.H.	1983	173
Dickson	J.G.	Segelquist, C.A.	1979	174
Diem	K.L.	Zeveloff, S.I.	1980	176
Dingledine	J.V.	Haufler, J.B.	1983	177
Dunlavy	J.C.		1935	179
Edgerton	P.J.	Thomas, J.W.	1978	180
Edwards	M.G.		1978	181
Egeline	S.		1980	183
Emlen	J.T.		1970	185
Emlen	J.T., Jr.		1956	187
Engstrom	K.		1955	189
Erdelen	M.		1984	191
Erksine	A.J.	McLaren, W.D.	1972	195
Erskine	A.J.		1968	192
Erskine	A.J.		1977	193
Euler	D.L.	Thompson, D.Q.	1978	196
Evans	K.E.		1978	197
Evans	K.E.		1978	198
Evans	K.E.	Conner, N.	1979	199
Ffolliott	P.F.		1983	200
Field	R.	Williams, B.K.	1985	201
Finley	R.B.		1965	202
Fischer	W.C.	McClelland, B.R.	1983	204
Flack	J.A.D.		1976	205
Forman	R.T.T.	Galli, A.E.;Leck, C.F.	1976	206
Forsman	E.D.	Meslow, E.C.;Strab, M.J.	1977	207
Fowler	N.E.	Howe, R.W.	1987	210
Fox	R.	Rhea, B.	1989	211
Francis	J.	Lumbis, K.	1979	212
Franzreb	K.E.		1975	213
Franzreb	K.E.		1977	214
Franzreb	K.E.		1978	215
Franzreb	K.E.		1983	216
Franzreb	K.E.	Ohmart, R.D.	1978	217
Freedman	B.	Beauchamp, C.;McLaren, I.A.;Tingley, S.I.	1981	218
Freedman	B.	Morgan, K.;Crowell, M.;Beauchamp, C.;Green, A.	1982	219
Freemark	K.E.	Merriam, H.G.	1986	220
Frissell	S.		1984	221
Fry	K.		1982	222
Fuller	R.J.	Moreton, B.O.	1987	223
Gale	R.M.		1973	226
Galli	A.E.	Leck, C.F.;Forman, R.T.T.	1976	228
Gates	J.E.	Mosher, J.A.	1981	231
Gauthreaux	S.A. Jr.		1978	232
Gerell	R.		1988	234
Gill	J.D.	DeGraaf, R.M.;Thomas, J.W.	1974	238
Glowacinski	Z.		1975	239
Glowacinski	Z.		1979	240

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Glowacinski	Z.	Jarvinen, O.	1975	241
Glowacinski	Z.	Weiner, J.	1983	242
Godell	B.S.	Kimball, A.;Hunter, M.L., Jr.	1986	243
Gotfryd	A.	Hansell, R.I.C.	1986	244
Graham	R.		1989	246
Granholm	S.L.		1982	247
Gruell	G.E.	Schmidt, W.C.;Arno, S.F.;Reich, W.J.	1982	249
Gullion	G.W.		1977	250
Gullion	G.W.		1985	251
Gullion	G.W.		1986	252
Gutierrez	R.J.		1985	253
Gutierrez	R.J.	Carey, B. (tech. eds)	1985	255
Gutierrez	R.T.	Decker, D.J.;Howard, R.A., Jr.;Lassoie, J.P.	1979	254
Gysel	L.W.		1961	256
Hagar	D.C.		1960	258
Haila	U.	Jarvinen, O.;Vaisanen, R.A.	1980	259
Haila	Y.		1986	260
Hale	J.B.	Gregg, L.E.	1976	261
Hall	F.C.		1980	262
Hall	F.C.	Thomas, J.W.	1979	264
Hall	G.A.		1984	263
Hamilton	R.B.	Noble, R.E.	1975	265
Hardin	K.I.	Evans, K.E.	1977	266
Harestad	A.S.	Keisker, D.G.	1989	267
Harris	J.		1983	270
Harris	L.D.	Bowman, G.B.;McElveen, J.D.;Miller, R.I.;Trupe, S.	1978	271
Harris	L.D.	Maser, C.;McKee, A.	1982	272
Hassinger	J.D.	Liscinsky, S.A.;Shaw, S.P.	1975	273
Heinselman	M.L.		1973	276
Helle	P.		1985	277
Helle	P.		1987	278
Helle	P.	Fuller, R.J.	1988	279
Herrera	C.M.		1978	281
Herrera	C.M.		1978	280
Hicks	L.L.		1983	282
Holt	D.W.	Hillis, J.M.	1987	286
Hooper	R.G.		1978	288
Hooper	R.G.	Crawford, H.S.	1969	289
Hooper	R.G.	Crawford, H.S.;Harlow, R.F.	1973	290
Hooven	E.F.		1969	291
Hopkins	R.B.	Cassel, J.F.;Bjugstad, A.J.	1986	292
Horton	S.P.	Mannan, R.W.	1988	293
Howe	R.W.		1984	295
Hunter	M.L. Jr.		1986	299
Jackson	J.A.		1970	302
Jackson	J.A.		1977	303
Jackson	J.A.	Jackson, D.J.J.	1986	304
Jackson	J.A.	Lennartz, M.K.;Hooper, R.G.	1979	305
James	F.C.		1971	306
James	F.C.		1978	307
James	F.C.	Rathbun, S.	1981	308
James	F.C.	Shugart, H.H. Jr.	1970	309
James	F.C.	Wamer, N.O.	1982	310
Johnson	A.S.	Landers, J.L.	1982	313
Johnson	N.K.		1975	315
Johnson	R.R.	Jones, D.A., eds.	1977	317
Johnson	R.R.	McCormick, J.F., tech. coord.	1978	318
Johnston	D.W.		1970	319
Johnston	D.W.	Odum, E.P.	1956	322

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Jones	P.H.		1972	323
Karr	J.R.		1968	324
Karr	J.R.		1976	325
Karr	J.R.	Roth, R.R.	1971	326
Kayll	A.J.		1968	327
Keith	J.O.	Hunt, E.	1969	330
Kelsall	J.P.	Telfer, E.S.;Wright, T.D.	1977	331
Kendeigh	S.C.		1946	332
Kendeigh	S.C.		1948	334
Kerlinger	P.	Doremus, C.	1981	335
Kessler	W.B.		1979	336
Kessler	W.B.		1980	337
Kessler	W.B.	Kogut, T.E.	1985	338
Kilgore	B.M.		1971	340
Kimball	A.J.		1986	341
Komarek	R.		1963	345
Koonz	W.H.		1988	346
Kricher	J.C.	William, E.D., Jr.	1986	351
Kroodsma	R.L.		1982	352
Lack	D.		1933	353
Lack	D.		1939	354
Lack	D.	Lack, E.	1951	355
Lancia	R.A.	Adams, D.A.	1985	356
Landers	P.B.	MacMahon, J.A.	1980	357
Lanier	J.W.		1986	358
Larsen	J.A.		1980	359
Lautenschlager	R.A.		1986	361
Lawrence	G.E.		1966	362
Lay	D.W.		1938	363
Lennartz	M.	Lancia, R.	1989	365
Lennartz	M.R.	Bjugstad, A.J.	1975	364
Lorenberg	E.I.		1964	367
Lovejoy	T.E.		1972	368
Lovejoy	T.E.		1983	369
Lovejoy	T.E.	Bierregaard, R.O.;Rankin, J.M.;Schubart, H.O.R.	1983	370
Lovejoy	T.E.	Rankin, J.M.;Bierregaard, R.D.;Brown, K.S.;Emmons, L.H.;Van der	1984	371
Lowe	P.O.	Ffolliott, P.F.;Dieterich, J.H.;Patton, D.	1978	373
Luman	I.D.	Neitro, W.A.	1980	374
Lynch	J.F.	Whigham, K.F.	1984	375
Lynch	J.F.	Whitcomb, R.F.	1978	376
MacArthur	R.H.		1958	378
MacArthur	R.H.		1964	380
MacArthur	R.H.	Horn, H.S.	1969	381
MacArthur	R.H.	MacArthur, J. W.	1961	382
MacArthur	R.H.	MacArthur, J.W.;Preer, J.	1962	383
MacArthur	R.H.	Recher, H.;Cody, M.	1966	384
MacClintock	L.	Whitcomb, R.F.;Whitcomb, B.L.	1977	385
MacDonald	J.E.		1966	386
MacKenzie	D.I.	Sealy, S.G.;Sutherland, G.D.	1982	387
MacWhorter	R.		1987	390
Mannan	R.W.		1980	393
Mannan	R.W.		1982	394
Mannan	R.W.	Meslow, E.C.	1984	396
Mannan	R.W.	Meslow, E.C.;Wight, H.M.	1980	397
Manuwal	D.A.	Munger, G.	1978	398
Marcot	B.G.		1983	399
Marcot	B.G.	Raphael, M.G.;Gerry, K.H.	1983	401
Martin	N.D.		1960	403
Martin	T.E.		1980	404

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Martin	T.E.		1988	405
Martin	T.E.	Karr, J.R.	1986	406
Marzluff	J.M.	Lyon, L.J.	1983	407
Maser	C.R.	Anderson, R.G.;Cromack, K. Jr.;Williams, J.T.;Martin, R.E.	1979	408
Mathisen	J.E.		1968	410
Mathisen	J.E.	Sorenson, D.J.;Frenzel, L.D.;Dunstan, T.C.	1977	412
Maurer	B.A.	McArthur, L.B.;Whitmore, R.C.	1981	414
Maurer	B.A.	McArthur, L.B.;Whitmore, R.C.	1981	413
Mawson	J.C.	Thomas, J.W.;DeGraaf, R.M.	1976	415
McCelland	B.R.		1980	419
McCelland	B.R.	Frissel, S.S.;Fischer, W.C.;Halvorson, C.H.	1979	421
McCelland	B.R.	Frissell, S.S.	1975	420
McClelland	B.R.		1977	418
McComb	W.C.	Bonney. S.A.;Sheffield, R.M.;Cost, N.D.	1986	424
McComb	W.C.	Muller, R.N.	1983	425
McComb	W.C.	Noble, R.E.	1980	426
McComb	W.C.	Rumsey, R.L.	1983	427
McCoy	E.D.		1982	428
McGarigal	K.	Faser, J.D.	1984	429
McLellan	C.H.	Dobson, A.P.;Wilcove, D.S.;Lynch, J.F.	1986	430
Mealy	S.P.	Horn, J.R.	1981	432
Medin	D.E.		1985	433
Medin	D.E.		1985	434
Medin	D.E.	Booth, G.D.	1989	435
Menasco	K.A.		1983	436
Meslow	E.C.		1978	437
Meslow	E.C.	Maser, C.;Verner, J.	1981	438
Meslow	E.C.	Wight, H.M.	1975	439
Meyers	J.M.	Johnson, A.S.	1978	440
Micheal	E.D.	Thornburgh, P.I.	1971	441
Miller	E.	Miller, D.R.	1980	442
Moeur	M.		1989	445
Monkkonen	M.	Helle, P.	1987	446
Monson	G.		1941	447
Moore	N.W.	Hooper, M.D.	1975	448
Morely	A.		1940	449
Morgan	K.	Freedman, B.	1986	451
Morgan	K.H.	Wetmore, S.P.;Smith, G.E.J.;Keller, R.A.	1989	452
Moriarty	J.J.	McComb, W.C.	1983	453
Morrison	M.L.		1981	454
Morrison	M.L.		1982	455
Morrison	M.L.	Melow, E.C.	1983	458
Morrison	M.L.	Meslow, E.C.	1983	456
Morrison	M.L.	Meslow, E.C.	1983	457
Morrison	M.L.	Meslow, E.C.	1984	460
Morrison	M.L.	Meslow, E.C.	1984	459
Morrison	M.L.	Raphael, M.G.;Heald, R.C.	1983	461
Morrison	M.L.	Timossi, I.C.;With, K.A.	1987	462
Morrison	M.L.	With, K.A.;Timossi, I.C.	1986	463
Morse	D.H.		1977	464
Moss	D.		1978	467
Moss	D.		1978	466
Moss	D.	Taylor, P.N.;Easterbee, N.	1979	468
Myers	C.A.	Morris, M.J.	1975	471
Nagy	J.G.	Schwartz, C.C.		473
Nero	R.W.	Clark, R.J.;Knaptor, R.J.;Hamre, R.H. eds	1987	475
Newton	I.		1983	476
Niemi	G.J.	Hanowski, J.M.	1984	478
Niemi	G.J.	Pfannmuller, L.	1979	479

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Nilsson	S.G.		1979	481
Noble	R.E.	Hamilton, R.B.	1976	482
Noon	B.R.		1981	483
Noon	B.R.	Able, K.P.	1978	484
Noon	B.R.	Bingman, V.P.;Noon, J.P.	1979	485
O'Meura	T.E.	Haufler, J.B.;Stelter, L.H.;Nagy, J.G.	1981	487
Odum	E.P.		1950	488
Oelke	H.		1967	489
Oliveri	S.F.		1986	490
Opdam	P.	Schotman, A.	1986	491
Patrice	R.		1987	495
Pearson	D.L.		1975	500
Perkins	C.J.		1973	501
Perkins	C.J.		1974	502
Peterson	A.		1986	503
Peterson	B.	Gauthier, G.	1985	504
Peterson	E.B.	Peterson, N.M.	1983	505
Petit	D.R.	Petit, K.E.;Grubb, T.C., Jr.	1985	507
Pinowski	B.C.		1976	510
Probst	J.R.		1979	512
Probst	J.R.		1988	513
Ranney	J.W.	Bruner, M.C.;Levenson, J.B.	1981	516
Raphael	M.G		1980	517
Raphael	M.G.		1983	518
Raphael	M.G.		1984	519
Raphael	M.G.	White, M.	1984	521
Rasmussen	W.O.	Ffolliott, P.F.	1983	524
Recher	H.		1969	525
Repenning	R.W.	Labisky, R.F.	1985	526
Reynolds	R.T.		1983	527
Reynolds	R.T.	Linkhart, B.D.;Jeanson, J.	1985	528
Rice	J.	Anderson, B.W.;Ohmart, R.D.	1984	530
Robbins	C.S.		1979	535
Robbins	C.S.	Dawson, D.K.;Dowell, B.A.	1989	536
Roble	R.J.	Browning, N.G.	1981	538
Roe	N.A.		1974	539
Roppe	J.A.	Hein, D.	1978	541
Rosenburg	D.K.	Fraser, J.D.;Stauffer, D.F.	1988	542
Rotenberry	J.T.	Wiens, J.A.	1981	543
Roth	R.R.		1976	544
Rov	N.		1975	545
Rowe	J.S.	Scotter, G.W.	1973	546
Runde	D.E.	Capen, D.E.	1987	548
Salt	G.W.		1957	550
Samson	F.B.		1980	552
Sanders	C.J.		1970	553
Sanderson	H.R.Bull,	Edgerton, P.J.	1980	554
Savidge	J.A.		1978	556
Schemnitz	S.D.		1973	557
Schemnitz	S.D.		1976	558
Schoen	J.W.	Wallmo, O.C.;Kirchhoff, M.D.	1981	559
Schroeder	R.L.		1982	560
Schroeder	R.L.		1982	563
Schroeder	R.L.		1983	561
Schroeder	R.L.		1983	562
Schultz	C.D.	Company Ltd.	1973	564
Schwab	F.E.		1979	565
Scott	V.E.		1978	566
Scott	V.E.		1979	567

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Scott	V.E.	Crouch, G.L.	1987	568
Scott	V.E.	Crouch, G.L.	1988	571
Scott	V.E.	Crouch, G.L.	1988	569
Scott	V.E.	Crouch, G.L.	1988	570
Scott	V.E.	Crouch, G.L.;Whelan, J.A.	1982	572
Scott	V.E.	Evans, K.E.;Patton, D.R.;Stone, C.P.	1977	573
Scott	V.E.	Gottfried, G.J.	1983	574
Scott	V.E.	Oldemeyer, J.L.	1983	575
Scott	V.E.	Whelan, J.A.;Alexander, R.R.	1978	576
Scott	V.E.	Whelan, J.A.;Svoboda, P.L.	1980	577
Scotter	G.W.		1972	578
Scoullar	K.A.		1980	579
Sedgewick	J.A.	Knopf, F.L.	1986	580
Servos	M.C.		1987	582
Seymour	R.S.		1986	583
Shaffer	M.L.		1985	584
Sheffield	R.M.		1981	585
Shugart	H.H.	Anderson, S.H.;Strand, R.H.	1975	589
Shugart	H.H.	Crow, T.R.;Hett, J.M.	1973	588
Shugart	H.H.	Dueser, R.D.;Anderson, S.H.	1974	590
Shugart	H.H.	James, D.	1973	591
Shugart	H.H.	Smith, T.M.;Kitchings, J.T.;Kroodsma, R.L.	1978	592
Siderits	K.	Radtke, R.E.	1977	594
Silovsky	G.D.	Pinto, C.	1974	595
Slagsvold	T.		1977	596
Slusher	J.P.	Hinkley, T.M., eds.	1974	598
Small	M.F.	Johnson, W.N. Jr.	1986	599
Smith	D.R., tech		1975	600
Smith	K.G.		1980	602
Smith	T.M.	Shugart, H.H.;West, D.C.		603
Smith	T.M.	Shugart, H.H.;West, D.C.	1981	604
Snyder	D.P.		1950	605
Sousa	P.J.		1982	606
Sousa	P.J.		1983	607
Sousa	P.J.		1983	608
Sousa	P.J.		1987	609
Spires	S.	Bendell, J.F.	1982	610
Sprunt	A. IV		1975	611
Stauffer	D.F.	Best, L.B.	1980	613
Stauffer	D.F.	Best, L.B.	1982	614
Stelfox	J.G.		1984	615
Stevens	L.E.	Brown, B.T.;Simpson, J.M.;Johnson, R.R.	1977	616
Stewart	R.E.	Aldrich, J.W.	1949	617
Stoddard	H.L. Sr.		1963	618
Strelke	W.K.	Dickson, J.G.	1980	619
Stubblefield	T.C.		1980	620
Styskel	E.W.		1983	621
Swallow	S.K.		1986	622
Swift	B.L.	Larson, J.S.;DeGraff, R.M.	1984	623
Szaro	R.C.		1980	624
Szaro	R.C.	Balda, R.P.	1979	625
Szaro	R.C.	Balda, R.P.	1982	626
Szaro	R.C.	Balda, R.P.	1986	627
Taylor	C.M.	Taylor, W.E.	1979	630
Taylor	D.L.		1973	632
Taylor	D.L.		1979	633
Taylor	D.L.	Barmore, W.J. Jr.	1980	634
Telfer	E.S.		1974	635
Telfer	E.S.		1976	636

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Telfer	E.S.		1977	637
Telfer	E.S.		1977	639
Telfer	E.S.		1978	638
Temple	S.A.	Maseman, M.J.;Ambuel, B.	1979	641
Theberge	J.B.		1976	642
Thomas	J.W.	Anderson, R.G.;Maser, C.;Bull, E.L.	1979	644
Thomas	J.W.	Crouch, G.L.;Bumstead, R.S.;Bryant, L.D.	1975	645
Thomas	J.W.	DeGraaf, R.M.;Mawson, J.C.	1977	646
Thomas	J.W.	Maser, C.;Rodiek, J.E.	1978	647
Thomas	J.W.	Miller, R.;Maser, C.;Anderson, R.;Carter, B.	1978	651
Thomas	J.W.	Miller, R.J.;Black, H.;Rodick, J.E.;Maser, C.	1976	649
Thomas	J.W.	Miller, R.J.;Maser, C.;Anderson, R.G.;Carter, B.E.	1979	650
Thomas	J.W.	Ruggiero, L.F.;Mannan, R.W.;Schoen, J.W.;Lancia, R.A.	1988	652
Thomas	J.W., tech		1979	643
Tilghman	N.G.		1985	653
Tilghman	N.G.		1987	654
Titterington	R.W.	Crawford, H.S.;Burgason, B.N.	1979	656
Titus	R.		1983	657
Todd	C.S.	Owen, R.B., Jr.	1986	658
Tramer	E.J.		1969	659
Tubbs	A.A.		1980	661
Van Horne	B.		1983	663
Verner	J.		1975	667
Wagner	J.L.		1981	669
Weaver	M.	Kellman, M.	1981	671
Weaver	M.	Kellman, M.	1981	672
Webb	W.L.		1977	673
Webb	W.L.	Behrend, D.F.;Sarworn, B.	1977	674
Wein	R.W.	Riewe, K.R.;Methven, I.R., eds.	1982	675
Welsh	D.A.		1981	676
Welsh	D.A.		1983	677
Welsh	D.A.		1988	679
Welsh	D.A.	Fillman, D.R.	1980	680
West	G.C.	DeWolfe, B.B.	1974	681
Westworth	D.A.	Brusnyk, L.M.;Burns, G.R.	1984	682
Wetmore	S.P	Keller, R.A.;Smith, G.E.S.	1985	685
Wetmore	S.P.	Booth, B.	1886	683
Whitcomb	B.L.	Whitcomb, R.F.;Bystrak, D.	1977	685
Whitcomb	R.F.		1977	686
Whitfield	D.W.A.	Gerrard, J.M.;Maher, W.J.;Davis, D.W.	1974	689
Whitney	R.D.	McClain, K.M., eds.	1981	690
Wiens	J.A.		1975	692
Wiens	J.A.		1978	691
Wight	H.M.		1974	693
Wilcove	D.S.		1985	694
Wilcove	D.S.		1985	695
Wilcove	D.S.		1987	696
Wilcove	D.S.	Terborgh, J.W.	1984	697
Williams	J.B.		1975	698
Williamson	K.		1970	700
Williamson	K.		1972	701
Willson	M.F.		1972	703
Willson	M.F.		1976	704
Winkler	D.W.	Dana, G.	1977	705
Winternitz	B.L.		1976	706
Winternitz	B.L.		1980	707
Winternitz	B.L.	Cahn, H.	1983	708
Wood	G.W.	Niles, L.J.	1978	709
Yahner	R.H.		1986	711

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Yahner	R.H.		1987	712
Yahner	R.H.	Scott, D.P.	1988	713
Yamasaki	M.	Tubbs, C.	1986	714
Yeager	L.E.		1955	715
Zarnowitz	J.E.	Manuwal, D.A.	1985	717
Zeedyk	W.D.	Evans, K.E.	1975	718

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AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Airola	D.A.	Barrett, R.H.	1985	9
Allen	A.W.		1987	11
Ambuel	B.	Temple, S.A.	1983	13
Anderson	R.J.		1985	15
Anderson	S.H.		1979	16
Anderson	S.H.		1979	17
Anderson	S.H.		1980	18
Anderson	S.H.		1981	19
Anderson	S.H.	Robbins, C.S.	1981	21
Anderson	S.H.	Shugart, H.H.	1974	22
Anonymous			0	1
Apfelbaum	S.	Haney, A.	1981	24
Arbuckle	J.		1986	25
Askins	R.A.	Philbrick, M.J.	1987	26
Askins	R.A.	Philbrick, M.J.;Sugeno, D.S.	1987	27
Austin	D.D.	Perry, M.L.	1979	28
Back	G.N.		1979	29
Back	G.N.		1982	30
Balda	R.P.		1975	33
Balda	R.P.	Gaud, W.S.;Brawn, J.D.	1983	34
Bamford	R.		1985	36
Bamford	R.		1986	37
Bart	J.		1979	39
Bissonette	J.A., ed.		1986	55
Black	H. Jr.	Thomas, J.W.	1978	56
Blake	J.G.		1983	59
Blake	J.G.	Karr, J.R.	1987	62
Blood	D.A.	Anweiler, G.G.	1984	64
Bock	C.E.	Bock, J.H.	1983	65
Brawn	J.D.	Elder, W.H.;Evans, K.E.	1982	72
Brawn	J.D.	Tannenbaum, B.;Evans, K.E.	1984	73
Bruns	H.		1960	76
Bryant	A.A.		1986	79
Bull	E.L.		1978	91
Bull	E.L.		1983	92
Bull	E.L.	Henjum, M.G.;Anderson, R.G.	1987	93
Bull	E.L.	Meslow, E.C.	1977	94
Bull	E.L.	Partridge, A.D.;Williams, W.G.	1981	96
Bull	E.L.	Peterson, S.R.;Thomas, J.W.	1986	97
Bull	E.L.	Twombly, A.D.;Quigley, T.M.	1980	98
Bunnell	F.L.	Allaye-Chan, A.	1984	99
Bunnell	F.L.	Eastman, D.S.	1976	100
Burke	M.		1983	102
Burr	R.M.	Jones, R.E.	1968	104
Capen	D.E.		1979	106
Capen	D.E.	Cooper, R.J.;DeGraaf, D.M.	1979	107
Capen	D.E.	Fenwick, J.W.;Inkley, D.B.;Boynton, A.C.	1986	108
Carey	A.B.	Gill, J.D.	1983	111
Carey	A.B.	Sanderson, H.R.	1981	112
Carmichael	D.B. Jr.	Guynn, D.C., Jr.	1983	113
Casey	D.	Hein, D.	1983	115
Chasko	G.G.	Gates, J.E.	1982	116
Cimon	N.		1983	117
Cline	S.P.	Berg, A.B.;Wight, H.M.	1980	120
Cline	S.P.	Phillips, C.A.	1983	121

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Conner	R.N.		1978	122
Conner	R.N.		1979	123
Conner	R.N.	Adkisson, C.S.	1976	127
Conner	R.N.	Crawford, H.S.	1974	128
Conner	R.N.	Dickson, J.G.;Locke, B.A.;Segelquist, C.A.	1983	130
Conner	R.N.	Dickson, J.G.;Williamson, J.H.	1983	131
Conner	R.N.	Hooper, R.G.;Crawford, H.S.;Mosby, H.S.	1975	132
Conner	R.N.	Locke, B.A.	1979	134
Conner	R.N.	Via, J.W.;Pather, I.D.	1979	138
Connor	R.N.	O'Halloran, K.A.	1987	137
Coulmbe	R.	Lemay, A.B.	1982	141
Crawford	H.S.	Hooper, R.G.;Titterington, R.W.	1981	142
Crawford	H.S.	Titterington, R.W.	1979	144
Crouch	G.L.		1983	148
Cunningham	J.B.	Balda, R.P.;Gaud, W.S.	1980	149
Currie	F.A.	Bamford, R.	1982	150
Curtis	R.L.	Ripley, T.H.	1975	151
Davis	J.W.	Goodwin, G.A.;Ockenfels, R.A., tech. coord.	1983	152
Dawson	D.K.		1979	155
DeByle	N.V.		1981	156
DeGraaf	R.M.	Chadwick, N.L.	1987	161
DeGraaf	R.M.	Evans, K.E., eds.	1979	160
DeGraaf	R.M.	Shingo, A.L.	1985	162
DeGraaf	R.M., tech		1978	157
DeGraaf	R.M., tech		1980	159
DellaSala	D.A.		1986	165
Diamond	A.W.		1986	170
Dickson	J.G.		1978	171
Dickson	J.G.	Segelquist, C.A.	1979	174
Diem	K.L.	Zeveloff, S.I.	1980	176
Dingledine	J.V.	Haufler, J.B.	1983	177
Edgerton	P.J.	Thomas, J.W.	1978	180
Edwards	M.G.		1978	181
Egeline	S.		1980	183
Evans	K.E.		1978	197
Evans	K.E.		1978	198
Evans	K.E.	Conner, N.	1979	199
Ffolliott	P.F.		1983	200
Field	R.	Williams, B.K.	1985	201
Fischer	W.C.	McClelland, B.R.	1983	204
Fowle	C.D.		1965	208
Fowler	N.E.	Howe, R.W.	1987	210
Francis	J.	Lumbis, K.	1979	212
Franzreb	K.E.		1975	213
Franzreb	K.E.		1977	214
Franzreb	K.E.		1978	215
Franzreb	K.E.	Ohmart, R.D.	1978	217
Frissell	S.		1984	221
Gale	R.M.		1973	226
Galli	A.E.	Leck, C.F.;Forman, R.T.T.	1976	228
Gary	H.L.	Morris, M.J.	1980	230
Giles	R.H.		1962	237
Gill	J.D.	DeGraaf, R.M.;Thomas, J.W.	1974	238
Godell	B.S.	Kimball, A.;Hunter, M.L., Jr.	1986	243
Gotfryd	A.	Hansell, R.I.C.	1986	244
Gould	W.P.		1962	245
Graham	R.		1989	246
Gruell	G.E.	Schmidt, W.C.;Arno, S.F.;Reich, W.J.	1982	249
Gullion	G.W.		1977	250

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Gullion	G.W.		1985	251
Gullion	G.W.		1986	252
Gutierrez	R.J.	Carey, B. (tech. eds)	1985	255
Gutierrez	R.T.	Decker, D.J.;Howard, R.A., Jr.;Lassoie, J.P.	1979	254
Gysel	L.W.		1961	256
Haila	Y.		1986	260
Hale	J.B.	Gregg, L.E.	1976	261
Hall	F.C.		1980	262
Hall	F.C.	Thomas, J.W.	1979	264
Hamilton	R.B.	Noble, R.E.	1975	265
Hardin	K.I.	Evans, K.E.	1977	266
Harris	J.		1983	270
Harris	L.D.	Maser, C.;McKee, A.	1982	272
Hassinger	J.D.	Liscinsky, S.A.;Shaw, S.P.	1975	273
Haws	K.		1987	274
Hicks	L.L.		1983	282
Holt	D.W.	Hillis, J.M.	1987	286
Hooper	R.G.		1978	288
Hooper	R.G.	Crawford, H.S.	1969	289
Hooper	R.G.	Crawford, H.S.;Harlow, R.F.	1973	290
Hopkins	R.B.	Cassel, J.F.;Bjugstad, A.J.	1986	292
Horton	S.P.	Mannan, R.W.	1988	293
Hunter	M.L. Jr.		1986	299
Jackson	J.A.		1977	303
Jackson	J.A.	Jackson, D.J.J.	1986	304
Jackson	J.A.	Lennartz, M.K.;Hooper, R.G.	1979	305
Johnson	A.S.	Landers, J.L.	1982	313
Johnson	R.R.	Jones, D.A., eds.	1977	317
Johnson	R.R.	McCormick, J.F., tech. coord.	1978	318
Kerlinger	P.	Doremus, C.	1981	335
Kessler	W.B.		1979	336
Kessler	W.B.	Kogut, T.E.	1985	338
Kimball	A.J.		1986	341
Koonz	W.H.		1988	346
Koplin	J.R.		1969	348
Lack	D.	Lack, E.	1951	355
Lanier	J.W.		1986	358
Lautenschlager	R.A.		1986	361
Lay	D.W.		1938	363
Lennartz	M.	Lancia, R.	1989	365
Lennartz	M.R.	Bjugstad, A.J.	1975	364
Lovejoy	T.E.		1983	369
Lovejoy	T.E.	Bierregaard, R.O.;Rankin, J.M.;Schubart, H.O.R.	1983	370
Lowe	P.O.	Ffolliott, P.F.;Dieterich, J.H.;Patton, D.	1978	373
Luman	I.D.	Neitro, W.A.	1980	374
Lynch	J.F.	Whigham, K.F.	1984	375
MacClintock	L.	Whitcomb, R.F.;Whitcomb, B.L.	1977	385
MacKenzie	J.M.D.		1952	388
MacWhorter	R.		1987	390
Mannan	R.W.		1980	393
Mannan	R.W.		1982	394
Mannan	R.W.	Meslow, E.C.	1984	396
Mannan	R.W.	Meslow, E.C.;Wight, H.M.	1980	397
Marcot	B.G.		1983	399
Marcot	B.G.	Raphael, M.G.;Gerry, K.H.	1983	401
Marzluff	J.M.	Lyon, L.J.	1983	407
Maser	C.R.	Anderson, R.G.;Cromack, K. Jr.;Williams, J.T.;Martin, R.E.	1979	408
Mathisen	J.E.		1988	411
Mathisen	J.E.	Sorenson, D.J.;Frenzel, L.D.;Dunstan, T.C.	1977	412

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Maurer	B.A.	McArthur, L.B.;Whitmore, R.C.	1981	414
Maurer	B.A.	McArthur, L.B.;Whitmore, R.C.	1981	413
McCelland	B.R.		1980	419
McCelland	B.R.	Frissel, S.S.;Fischer, W.C.;Halvorson, C.H.	1979	421
McCelland	B.R.	Frissell, S.S.	1975	420
McClelland	B.R.		1977	418
McComb	W.C.	Bonney. S.A.;Sheffield, R.M.;Cost, N.D.	1986	424
McComb	W.C.	Muller, R.N.	1983	425
McComb	W.C.	Noble, R.E.	1980	426
McComb	W.C.	Rumsey, R.L.	1983	427
McCoy	E.D.		1982	428
McGarigal	K.	Faser, J.D.	1984	429
McLellan	C.H.	Dobson, A.P.;Wilcove, D.S.;Lynch, J.F.	1986	430
Mealy	S.P.	Horn, J.R.	1981	432
Meslow	E.C.		1978	437
Meslow	E.C.	Maser, C.;Verner, J.	1981	438
Meslow	E.C.	Wight, H.M.	1975	439
Meyers	J.M.	Johnson, A.S.	1978	440
Micheal	E.D.	Thornburgh, P.I.	1971	441
Miller	E.	Miller, D.R.	1980	442
Moeur	M.		1989	445
Monson	G.		1941	447
Moriarty	J.J.	McComb, W.C.	1983	453
Morrison	M.L.		1981	454
Morrison	M.L.		1982	455
Morrison	M.L.	Meslow, E.C.	1983	456
Morrison	M.L.	Meslow, E.C.	1984	459
Morrison	M.L.	Raphael, M.G.;Heald, R.C.	1983	461
Morrison	M.L.	With, K.A.;Timossi, I.C.	1986	463
Moss	D.		1978	467
Myers	C.A.	Morris, M.J.	1975	471
Nero	R.W.	Clark, R.J.;Knaptor, R.J.;Hamre, R.H. eds	1987	475
Niemi	G.J.	Hanowski, J.M.	1984	478
Niemi	G.J.	Pfannmuller, L.	1979	479
Nilsson	S.G.		1979	481
Noble	R.E.	Hamilton, R.B.	1976	482
Noon	B.R.	Able, K.P.	1978	484
O'Meura	T.E.	Haufler, J.B.;Stelter, L.H.;Nagy, J.G.	1981	487
Oliveri	S.F.		1986	490
Opdam	P.	Schotman, A.	1986	491
Otvos	I.S.		1979	493
Pearce	P.A.	Garrity, N.R.	1981	497
Pearce	P.A.	Peakall, D.B.;Erskin, A.J.	1976	499
Pearce	P.A.	Peakall, D.B.;Erskine, A.J.	1979	498
Peterson	A.		1986	503
Peterson	E.B.	Peterson, N.M.	1983	505
Peterson	S.R.		1975	506
Pinowski	B.C.		1976	510
Plunkett	R.L.		1979	511
Probst	J.R.		1979	512
Probst	J.R.		1988	513
Ranney	J.W.	Bruner, M.C.;Levenson, J.B.	1981	516
Raphael	M.G		1980	517
Raphael	M.G.		1983	518
Raphael	M.G.		1984	519
Raphael	M.G.	White, M.	1984	521
Rasmussen	W.O.	Ffolliott, P.F.	1983	524
Repenning	R.W.	Labisky, R.F.	1985	526
Reynolds	R.T.		1983	527

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Reynolds	R.T.	Linkhart, B.D.;Jeanson, J.	1985	528
Rice	J.	Anderson, B.W.;Ohmart, R.D.	1984	530
Roach	B.A.		1974	533
Robbins	C.S.		1979	535
Robbins	C.S.	Dawson, D.K.;Dowell, B.A.	1989	536
Roble	R.J.	Browning, N.G.	1981	538
Roe	N.A.		1974	539
Rosenburg	D.K.	Fraser, J.D.;Stauffer, D.F.	1988	542
Runde	D.E.	Capen, D.E.	1987	548
Salwasser	H.	Tappeiner, J.C. II	1984	551
Samson	F.B.		1980	552
Schemnitz	S.D.		1973	557
Schroeder	R.L.		1982	560
Schroeder	R.L.		1982	563
Schroeder	R.L.		1983	561
Schroeder	R.L.		1983	562
Scott	V.E.		1978	566
Scott	V.E.		1979	567
Scott	V.E.	Crouch, G.L.	1987	568
Scott	V.E.	Crouch, G.L.	1988	571
Scott	V.E.	Crouch, G.L.	1988	569
Scott	V.E.	Crouch, G.L.	1988	570
Scott	V.E.	Crouch, G.L.;Whelan, J.A.	1982	572
Scott	V.E.	Gottfried, G.J.	1983	574
Scott	V.E.	Oldemeyer, J.L.	1983	575
Scott	V.E.	Whelan, J.A.;Alexander, R.R.	1978	576
Scott	V.E.	Whelan, J.A.;Svoboda, P.L.	1980	577
Sedgewick	J.A.	Knopf, F.L.	1986	580
Servos	M.C.		1987	582
Seymour	R.S.		1986	583
Shaffer	M.L.		1985	584
Sheffield	R.M.		1981	585
Shugart	H.H.	Anderson, S.H.;Strand, R.H.	1975	589
Shugart	H.H.	Dueser, R.D.;Anderson, S.H.	1974	590
Shugart	H.H.	Smith, T.M.;Kitchings, J.T.;Kroodsma, R.L.	1978	592
Shugart	H.H.	West, D.C.	1980	593
Siderits	K.	Radtke, R.E.	1977	594
Slusher	J.P.	Hinkley, T.M., eds.	1974	598
Small	M.F.	Johnson, W.N. Jr.	1986	599
Smith	D.R., tech		1975	600
Smith	K.G.		1980	602
Smith	T.M.	Shugart, H.H.;West, D.C.		603
Smith	T.M.	Shugart, H.H.;West, D.C.	1981	604
Sousa	P.J.		1982	606
Sousa	P.J.		1983	607
Sousa	P.J.		1983	608
Sousa	P.J.		1987	609
Sprunt	A. IV		1975	611
Stelfox	J.G.		1984	615
Stevens	L.E.	Brown, B.T.;Simpson, J.M.;Johnson, R.R.	1977	616
Strelke	W.K.	Dickson, J.G.	1980	619
Stubblefield	T.C.		1980	620
Styskel	E.W.		1983	621
Swallow	S.K.		1986	622
Szaro	R.C.		1980	624
Szaro	R.C.	Balda, R.P.	1979	625
Szaro	R.C.	Balda, R.P.	1982	626
Taber	R.D.	Manuwal, D.;West, S.D.;Raedeke, K.J.;deCalesta, D.	1981	628
Takekawa	J.Y.	Garton, E.O.;Lanelier, L.A.	1982	629

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Taylor	C.M.	Taylor, W.E.	1979	630
Taylor	D.L.		1973	632
Taylor	D.L.		1979	633
Telfer	E.S.		1976	636
Telfer	E.S.		1977	639
Telfer	E.S.		1978	638
Temple	S.A.	Maseman, M.J.;Ambuel, B.	1979	641
Thomas	J.W.	Anderson, R.G.;Maser, C.;Bull, E.L.	1979	644
Thomas	J.W.	Crouch, G.L.;Bumstead, R.S.;Bryant, L.D.	1975	645
Thomas	J.W.	DeGraaf, R.M.;Mawson, J.C.	1977	646
Thomas	J.W.	Maser, C.;Rodiek, J.E.	1978	647
Thomas	J.W.	Miller, R.;Maser, C.;Anderson, R.;Carter, B.	1978	651
Thomas	J.W.	Miller, R.J.;Black, H.;Rodick, J.E.;Maser, C.	1976	649
Thomas	J.W.	Miller, R.J.;Maser, C.;Anderson, R.G.;Carter, B.E.	1979	650
Thomas	J.W.	Ruggiero, L.F.;Mannan, R.W.;Schoen, J.W.;Lancia, R.A.	1988	652
Thomas	J.W., tech		1979	643
Tilghman	N.G.		1985	653
Tilghman	N.G.		1987	654
Titus	R.		1983	657
Todd	C.S.	Owen, R.B., Jr.	1986	658
Tubbs	A.A.		1980	661
Verner	J.		1975	667
Verner	J.		1981	666
Webb	W.L.		1977	673
Webb	W.L.	Behrend, D.F.;Sarworn, B.	1977	674
Welsh	D.A.		1981	676
Welsh	D.A.		1988	679
Westworth	D.A.	Brusnyk, L.M.;Burns, G.R.	1984	682
Whitcomb	B.L.	Whitcomb, R.F.;Bystrak, D.	1977	685
Whitcomb	R.F.		1977	686
Wiens	J.A.		1975	692
Wiens	J.A.		1978	691
Wilcove	D.S.		1985	695
Williamson	K.		1970	700
Williamson	K.		1972	701
Willner	G.R.	Gates, J.E.;Devlin, W.J.	1983	702
Winkler	D.W.	Dana, G.	1977	705
Wood	G.W.	Niles, L.J.	1978	709
Wood	G.W.	Niles, L.J.;Hendrick, R.M.;Davis, J.R.;Grimes, T.L.	1985	710
Yamasaki	M.	Tubbs, C.	1986	714
Zarnowitz	J.E.	Manuwal, D.A.	1985	717
Zeedyk	W.D.	Evans, K.E.	1975	718

SUBSECTION INDEX
LAND USE IMPACTS on HABITAT and BIRDS

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD
Ahlen	I.		1976	
Ambrose	R.E.		1975	
Ambuel	B.	Temple, S.A.	1983	
Anderson	S.H.		1979	
Anderson	S.H.	Mann, K.;Shugart, H.H., Jr.	1977	
Anonymous			0	
Arbuckle	J.		1986	
Askins	R.A.	Philbrick, M.J.	1987	
Austin	D.D.	Perry, M.L.	1979	
Back	G.N.		1979	
Back	G.N.		1982	
Barney	C.W.	Dils, R.E.	1972	
Bart	J.		1979	
Batten	L.A.	Pomeroy, D.E.	1969	
Beaver	D.L.		1976	
Bendell	J.F.		1974	
Bergstedt	B.	Niemi, G.J.	1974	
Best	L.B.	Stauffer, D.F.;Geier, A.R.	1979	
Bissonette	J.A., ed.		1986	
Blake	J.G.		1982	
Blake	J.G.		1983	
Blake	J.G.		1983	
Blake	J.G.	Karr, J.R.	1984	
Bock	C.E.	Bock, J.H.	1983	
Bryant	A.A.		1986	
Buckner	C.H.		1975	
Bunnell	F.L.	Eastman, D.S.	1976	1
Bureau of Land Management				1
Burr	R.M.		1969	1
Burr	R.M.	Jones, R.E.	1968	1
Capen	D.E.		1979	1
Chasko	G.G.	Gates, J.E.	1982	1
Clark	K.	Euler, D.;Armstrong, E.	1983	1
Cline	S.P.	Phillips, C.A.	1983	1
Conner	R.N.		1978	1
Conner	R.N.	Adkisson, C.S.	1974	1
Conner	R.N.	Adkisson, C.S.	1975	1
Conner	R.N.	Crawford, H.S.	1974	1
Conner	R.N.	Dickson, J.G.;Locke, B.A.;Segelquist, C.A.	1983	1
Conner	R.N.	Hooper, R.G.;Crawford, H.S.;Mosby, H.S.	1975	1
Conner	R.N.	Locke, B.A.	1979	1
Conner	R.N.	Via, J.W.;Pather, I.D.	1979	1
Connor	R.N.	O'Halloran, K.A.	1987	1
Coulmbe	R.	Lemay, A.B.	1982	1
Crawford	H.S.	Hooper, R.G.;Titterington, R.W.	1981	1
Crawford	H.S.	Titterington, R.W.	1979	1
Cross	C.W.		1963	1
Crouch	G.L.		1983	1
Curtis	R.L.	Ripley, T.H.	1975	1
Davis	J.W.	Goodwin, G.A.;Ockenfels, R.A., tech. coord.	1983	1
Dawson	D.K.		1979	1
DeByle	N.V.		1981	1
DeGraaf	R.M.	Evans, K.E., eds.	1979	1
DeGraaf	R.M., tech		1978	1
DeGraaf	R.M., tech		1980	1

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD
DellaSala	D.A.		1986	1
DeWeese	L.R.	Henny, C.J.;Floyd, R.L.;Bobal. K.A.;Schultz, A.W.	1979	1
Diamond	A.W.		1986	1
Dickson	J.G.		1978	1
Dickson	J.G.	Conner, R.N.;Williamson, J.H.	1983	1
Dickson	J.G.	Segelquist, C.A.	1979	1
Diem	K.L.	Zeveloff, S.I.	1980	1
Dingledine	J.V.	Haufler, J.B.	1983	1
Edgerton	P.J.	Thomas, J.W.	1978	1
Emlen	J.T.		1970	1
Environment Council			1979	1
Erskine	A.J.		1977	1
Euler	D.L.	Thompson, D.Q.	1978	1
Evans	K.E.		1978	1
Evans	K.E.		1978	1
Evans	K.E.	Conner, N.	1979	1
Ffolliott	P.F.		1983	2
Finley	R.B.		1965	2
Fischer	W.C.	McClelland, B.R.	1983	2
Forman	R.T.T.	Galli, A.E.;Leck, C.F.	1976	2
Forsman	E.D.	Meslow, E.C.;Strab, M.J.	1977	2
Franzreb	K.E.		1975	2
Franzreb	K.E.		1977	2
Franzreb	K.E.		1978	2
Franzreb	K.E.		1983	2
Franzreb	K.E.	Ohmart, R.D.	1978	2
Freedman	B.	Beauchamp, C.;McLaren, I.A.;Tingley, S.I.	1981	2
Freedman	B.	Morgan, K.;Crowell, M.;Beauchamp, C.;Green, A.	1982	2
Frissell	S.		1984	2
Fry	K.		1982	2
Fuller	R.J.	Moreton, B.D.	1987	2
Gerell	R.		1988	2
Glowacinski	Z.		1979	2
Gould	W.P.		1962	2
Granholm	S.L.		1982	2
Gruell	G.E.	Schmidt, W.C.;Arno, S.F.;Reich, W.J.	1982	2
Gullion	G.W.		1985	2
Gutierres	R.J.	Carey, B. (tech. eds)	1985	2
Gysel	L.W.		1961	2
Hagar	D.C.		1960	2
Haila	U.	Jarvinen, O.;Vaisanen, R.A.	1980	2
Haila	Y.		1986	2
Hale	J.B.	Gregg, L.E.	1976	2
Hall	G.A.		1984	2
Hamilton	R.B.	Noble, R.E.	1975	2
Hardin	K.I.	Evans, K.E.	1977	2
Harris	J.		1983	2
Harris	L.D.	Bowman, G.B.;McElveen, J.D.;Miller, R.I.;Trupe, S.	1978	2
Harris	L.D.	Maser, C.;McKee, A.	1982	2
Hassinger	J.D.	Liscinsky, S.A.;Shaw, S.P.	1975	2
Helle	P.		1985	2
Helle	P.		1987	2
Helle	P.	Fuller, R.J.	1988	2
Hicks	L.L.		1983	2
Holling	C.S.		1988	2
Hooper	R.G.		1978	2
Hooper	R.G.	Crawford, H.S.	1969	2
Hooper	R.G.	Crawford, H.S.;Harlow, R.F.	1973	2
Hooven	E.F.		1969	2

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD
Hopkins	R.B.	Cassel, J.F.;Bjugstad, A.J.	1986	2
Horton	S.P.	Mannan, R.W.	1988	2
Howe	R.W.		1984	2
Hunter	M.L. Jr.		1986	2
Jackson	J.A.		1977	3
Jackson	J.A.	Jackson, D.J.J.	1986	3
Jackson	J.A.	Lennartz, M.K.;Hooper, R.G.	1979	3
Johnson	A.S.	Landers, J.L.	1982	3
Johnson	R.R.	McCormick, J.F., tech. coord.	1978	3
Johnston	D.W.		1970	3
Johnston	D.W.		1975	3
Johnston	D.W.	Odum, E.P.	1956	3
Jones	P.H.		1972	3
Karr	J.R.		1968	3
Keith	J.O.	Hunt, E.	1969	3
Kendeigh	S.C.		1946	3
Kerlinger	P.	Doremus, C.	1981	3
Kessler	W.B.		1979	3
Kessler	W.B.		1980	3
Kessler	W.B.	Kogut, T.E.	1985	3
Kilgore	B.M.		1971	3
Kimball	A.J.		1986	3
Kricher	J.C.	William, E.D., Jr.	1986	3
Kroodsma	R.L.		1982	3
Lack	D.		1939	3
Lack	D.	Lack, E.	1951	3
Lanier	J.W.		1986	3
Lautenschlager	R.A.		1986	3
Lawrence	G.E.		1966	3
Lennartz	M.	Lancia, R.	1989	3
Lorenberg	E.I.		1964	3
Lovejoy	T.E.	Bierregaard, R.O.;Rankin, J.M.;Schubart, H.O.R.	1983	3
Lovejoy	T.E.	Rankin, J.M.;Bierregaard, R.D.;Brown, K.S.;Emmons, L.H.; Van der Voort, M.E.	1984	3
Lynch	J.F.	Whigham, K.F.	1984	3
Lynch	J.F.	Whitcomb, R.F.	1978	3
MacDonald	J.E.		1966	3
Mannan	R.W.		1980	3
Mannan	R.W.		1982	3
Mannan	R.W.	Meslow, E.C.	1984	3
Manuwal	D.A.	Munger, G.	1978	3
Marcot	B.G.		1983	3
Marzluff	J.M.	Lyon, L.J.	1983	4
Maser	C.R.	Anderson, R.G.;Cromack, K. Jr.;Williams, J.T.;Martin, R.E.	1979	4
Mathisen	J.E.		1968	4
Maurer	B.A.	McArthur, L.B.;Whitmore, R.C.	1981	4
McCelland	B.R.		1980	4
McClelland	B.R.		1977	4
McComb	W.C.	Muller, R.N.	1983	4
McComb	W.C.	Noble, R.E.	1980	4
McComb	W.C.	Rumsey, R.L.	1983	4
McLellan	C.H.	Dobson, A.P.;Wilcove, D.S.;Lynch, J.F.	1986	4
Medin	D.E.		1985	4
Medin	D.E.	Booth, G.D.	1989	4
Meslow	E.C.		1978	4
Meslow	E.C.	Wight, H.M.	1975	4
Meyers	J.M.	Johnson, A.S.	1978	4
Micheal	E.D.	Thornburgh, P.I.	1971	4
Morgan	K.	Freedman, B.	1986	4

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD
Morgan	K.H.	Wetmore, S.P.;Smith, G.E.J.;Keller, R.A.	1989	4
Moriarty	J.J.	McComb, W.C.	1983	4
Morrison	M.L.		1982	4
Morrison	M.L.	Melow, E.C.	1983	4
Morrison	M.L.	Meslow, E.C.	1983	4
Morrison	M.L.	Meslow, E.C.	1983	4
Morrison	M.L.	Meslow, E.C.	1984	4
Morrison	M.L.	Meslow, E.C.	1984	4
Moss	D.	Taylor, P.N.;Easterbee, N.	1979	4
Myers	C.A.	Morris, M.J.	1975	4
Nagy	J.G.	Schwartz, C.C.		4
Newton	I.		1983	4
Niemi	G.J.	Hanowski, J.M.	1984	4
Nilsson	S.G.		1979	4
Noble	R.E.	Hamilton, R.B.	1976	4
Noon	B.R.	Bingman, V.P.;Noon, J.P.	1979	4
O'Meura	T.E.	Haufler, J.B.;Stelter, L.H.;Nagy, J.G.	1981	4
Oliveri	S.F.		1986	4
Perkins	C.J.		1973	5
Perkins	C.J.		1974	5
Peterson	A.		1986	5
Peterson	E.B.	Peterson, N.M.	1983	5
Probst	J.R.		1979	5
Ramsden	D.J.	Lyon, L.J.;Halvorson, G.L.	1979	5
Raphael	M.G		1980	5
Raphael	M.G.		1983	5
Repenning	R.W.	Labisky, R.F.	1985	5
Richmond	M.L.	Henny, C.J.;Floyd, R.L.;Mannan, R.W.;Finch, D.M.;DeWeese, L.	1979	5
Robbins	C.S.		1979	5
Robbins	C.S.	Dawson, D.K.;Dowell, B.A.	1989	5
Roble	R.J.	Browning, N.G.	1981	5
Roe	N.A.		1974	5
Samson	F.B.		1980	5
Sanderson	H.R.Bull,	Edgerton, P.J.	1980	5
Savidge	J.A.		1978	5
Schemnitz	S.D.		1976	5
Schoen	J.W.	Wallmo, O.C.;Kirchhoff, M.D.	1981	5
Schultz	C.D.	Company Ltd.	1973	5
Schwab	F.E.		1979	5
Scott	V.E.		1979	5
Scott	V.E.	Crouch, G.L.	1987	5
Scott	V.E.	Crouch, G.L.	1988	5
Scott	V.E.	Crouch, G.L.;Whelan, J.A.	1982	5
Scott	V.E.	Gottfried, G.J.	1983	5
Scott	V.E.	Oldemeyer, J.L.	1983	5
Scoullar	K.A.		1980	5
Shugart	H.H.	Dueser, R.D.;Anderson, S.H.	1974	5
Silovsky	G.D.	Pinto, C.	1974	5
Slagsvold	T.		1977	5
Slusher	J.P.	Hinkley, T.M., eds.	1974	5
Smith	D.R., tech		1975	6
Smith	K.G.		1980	6
Stauffer	D.F.	Best, L.B.	1980	6
Stelfox	J.G.		1984	6
Strelke	W.K.	Dickson, J.G.	1980	6
Stubblefield	T.C.		1980	6
Styskel	E.W.		1983	6
Szaro	R.C.		1980	6
Szaro	R.C.	Balda, R.P.	1979	6

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD
Szaro	R.C.	Balda, R.P.	1982	6
Szaro	R.C.	Balda, R.P.	1986	6
Taber	R.D.	Manuwal, D.;West, S.D.;Raedeke, K.J.;deCalesta, D.	1981	6
Taylor	C.M.	Taylor, W.E.	1979	6
Taylor	D.L.	Barmore, W.J. Jr.	1980	6
Telfer	E.S.		1974	6
Telfer	E.S.		1976	6
Telfer	E.S.		1977	6
Telfer	E.S.		1977	6
Telfer	E.S.		1978	6
Telfer	E.S.		1981	6
Temple	S.A.	Maseman, M.J.;Ambuel, B.	1979	6
Thomas	J.W.	Crouch, G.L.;Bumstead, R.S.;Bryant, L.D.	1975	6
Thomas	J.W.	Miller, R.;Maser, C.;Anderson, R.;Carter, B.	1978	6
Thomas	J.W.	Miller, R.J.;Black, H.;Rodick, J.E.;Maser, C.	1976	6
Thomas	J.W.	Miller, R.J.;Maser, C.;Anderson, R.G.;Carter, B.E.	1979	6
Titus	R.		1983	6
Trial	H., Jr.		1986	6
Tubbs	A.A.		1980	6
Verner	J.		1981	6
Webb	W.L.		1977	6
Webb	W.L.	Behrend, D.F.;Sarworn, B.	1977	6
Welsh	D.A.		1981	6
Welsh	D.A.		1983	6
Welsh	D.A.	Fillman, D.R.	1980	6
Westworth	D.A.	Brusnyk, L.M.;Burns, G.R.	1984	6
Wetmore	S.P	Keller, R.A.;Smith, G.E.S.	1985	6
Wetmore	S.P.	Booth, B.	1886	6
Whitcomb	B.L.	Whitcomb, R.F.;Bystrak, D.	1977	6
Whitcomb	R.F.		1977	6
Wiens	J.A.		1975	6
Wiens	J.A.		1978	6
Wight	H.M.		1974	6
Wilcove	D.S.		1985	6
Wilcove	D.S.		1987	6
Williamson	K.		1970	7
Williamson	K.		1972	7
Winkler	D.W.	Dana, G.	1977	7
Wood	G.W.	Niles, L.J.	1978	7
Wood	G.W.	Niles, L.J.;Hendrick, R.M.;Davis, J.R.;Grimes, T.L.	1985	7
Yahner	R.H.		1986	7
Yahner	R.H.		1987	7
Yahner	R.H.	Scott, D.P.	1988	7
Yamasaki	M.	Tubbs, C.	1986	7
Zarnowitz	J.E.	Manuwal, D.A.	1985	7
Zeedyk	W.D.	Evans, K.E.	1975	7

SUBSECTION INDEX
MANAGEMENT RECOMMENDATIONS/GUIDELINES

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Anderson	R.J.		1985	15
Anonymous			0	1
Beebe	S.B.		1974	44
Brawn	J.D.	Elder, W.H.;Evans, K.E.	1982	72
Bull	E.L.	Meslow, E.C.	1977	94
Bull	E.L.	Twombly, A.D.;Quigley, T.M.	1980	98
Cline	S.P.	Berg, A.B.;Wight, H.M.	1980	120
Cline	S.P.	Phillips, C.A.	1983	121
Connor	R.N.	O'Halloran, K.A.	1987	137
Coulmbe	R.	Lemay, A.B.	1982	141
Cunningham	J.B.	Balda, R.P.;Gaud, W.S.	1980	149
Currie	F.A.	Bamford, R.	1982	150
Davis	J.W.	Goodwin, G.A.;Ockenfels, R.A., tech. coord.	1983	152
Dawson	D.K.		1979	155
DeGraaf	R.M.	Shingo, A.L.	1985	162
DeGraaf	R.M., tech		1978	157
Dickson	J.G.		1978	171
Dickson	J.G.	Conner, R.N.;Williamson, J.H.	1983	173
Edwards	M.G.		1978	181
Environment Council			1979	190
Evans	K.E.	Conner, N.	1979	199
Ffolliott	P.F.		1983	200
Francis	J.	Lumbis, K.	1979	212
Franzreb	K.E.		1977	214
Frissell	S.		1984	221
Gale	R.M.		1973	226
Hassinger	J.D.	Liscinsky, S.A.;Shaw, S.P.	1975	273
Haws	K.		1987	274
Hooper	R.G.		1978	288
Koonz	W.H.		1988	346
Mannan	R.W.		1982	394
Mannan	R.W.	Meslow, E.C.;Wight, H.M.	1980	397
Maser	C.R.	Anderson, R.G.;Cromack, K. Jr.;Williams, J.T.;Martin, R.E.	1979	408
McCelland	B.R.	Frissel, S.S.;Fischer, W.C.;Halvorson, C.H.	1979	421
McCelland	B.R.	Frissell, S.S.	1975	420
McClelland	B.R.		1977	418
McComb	W.C.	Bonney. S.A.;Sheffield, R.M.;Cost, N.D.	1986	424
McComb	W.C.	Noble, R.E.	1980	426
Morrison	M.L.		1982	455
O'Meura	T.E.	Haufler, J.B.;Stelter, L.H.;Nagy, J.G.	1981	487
Raphael	M.G.	White, M.	1984	521
Reynolds	R.T.		1983	527
Scott	V.E.	Whelan, J.A.;Alexander, R.R.	1978	576
Small	M.F.	Johnson, W.N. Jr.	1986	599
Smith	K.G.		1980	602
Styskel	E.W.		1983	621
Swallow	S.K.		1986	622
Szaro	R.C.	Balda, R.P.	1979	625
Thomas	J.W.	Miller, R.J.;Black, H.;Rodick, J.E.;Maser, C.	1976	649
Titus	R.		1983	657
Zarnowitz	J.E.	Manuwal, D.A.	1985	717

SUBSECTION INDEX
FOREST ECOLOGY

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Ahlgren	I.F.	Ahlgren, C.E.	1960	7
Anderson	S.H.		1979	17
Anderson	S.H.		1980	18
Back	G.N.		1979	29
Balda	R.P.		1975	33
Bendell	J.F.		1974	48
Bock	C.E.	Raphael, M.;Bock, J.M.	1978	67
Bruns	H.		1960	76
Buckner	C.H.		1975	80
Bull	E.L.		1983	92
Bull	E.L.	Partridge, A.D.;Williams, W.G.	1981	96
Bunnell	F.L.	Eastman, D.S.	1976	100
Capen	D.E.		1979	106
Carey	A.B.		1983	110
Cline	S.P.	Berg, A.B.;Wight, H.M.	1980	120
Conner	R.N.	Locke, B.A.	1982	135
Conner	R.N.	Miller, O.K. Jr.;Adkisson, C.S.	1976	136
Connor	R.N.	O'Halloran, K.A.	1987	137
Corns	I.G.W.	La Roi, G.H.	1976	139
Crouch	G.L.		1983	148
Crouch	G.L.		1983	148
DeGraaf	R.M.		1978	158
Diem	K.L.	Zeveloff, S.I.	1980	176
Fischer	W.C.	McClelland, B.R.	1983	204
Forsman	E.D.	Meslow, E.C.;Strab, M.J.	1977	207
Franzreb	K.E.		1978	215
Franzreb	K.E.	Ohmart, R.D.	1978	217
Frissell	S.		1984	221
Gage	S.H.	Miller, C.A.	1978	224
Gale	R.M.		1973	226
Gerell	R.		1988	234
Glowacinski	Z.		1975	239
Glowacinski	Z.	Jarvinen, O.	1975	241
Gullion	G.W.		1977	250
Gullion	G.W.		1985	251
Gullion	G.W.		1986	252
Gutierrez	R.T.	Decker, D.J.;Howard, R.A., Jr.;Lassoie, J.P.	1979	254
Gysel	L.W.		1961	256
Haila	U.	Jarvinen, O.;Vaisanen, R.A.	1980	259
Hamilton	R.B.	Noble, R.E.	1975	265
Heinselman	M.L.		1973	276
Helle	P.		1985	277
Helle	P.	Fuller, R.J.	1988	279
Holling	C.S.		1988	284
Holmes	R.T.	Robinson, S.K.	1981	285
Johnson	A.S.	Landers, J.L.	1982	313
Johnson	P.C.	Denton, R.E.	1975	316
Kayll	A.J.		1968	327
Kelsall	J.P.	Telfer, E.S.;Wright, T.D.	1977	331
Kendeigh	S.C.		1948	334
Knight	F.R.		1958	343
Komarek	R.		1963	345
Larsen	J.A.		1980	359
Lowe	P.O.	Ffolliott, P.F.;Dieterich, J.H.;Patton, D.	1978	373
Lynch	J.F.	Whigham, K.F.	1984	375

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
MacArthur	R.H.	MacArthur, J. W.	1961	382
Maser	C.R.	Anderson, R.G.;Cromack, K. Jr.;Williams, J.T.;Martin, R.E.	1979	408
McCambridge	W.F.	Knight, F.B.	1972	417
McComb	W.C.	Bonney. S.A.;Sheffield, R.M.;Cost, N.D.	1986	424
Menasco	K.A.		1983	436
Meslow	E.C.	Maser, C.;Verner, J.	1981	438
Morrison	M.L.	Raphael, M.G.;Heald, R.C.	1983	461
Noon	B.R.	Able, K.P.	1978	484
Otvos	I.S.		1979	493
Perkins	C.J.		1974	502
Plunkett	R.L.		1979	511
Ranney	J.W.	Bruner, M.C.;Levenson, J.B.	1981	516
Rasmussen	W.O.	Ffolliott, P.F.	1983	524
Recher	H.		1969	525
Rowe	J.S.	Scotter, G.W.	1973	546
Schoen	J.W.	Wallmo, O.C.;Kirchhoff, M.D.	1981	559
Scotter	G.W.		1972	578
Shugart	H.H.	Crow, T.R.;Hett, J.M.	1973	588
Shugart	H.H.	James, D.	1973	591
Stoddard	H.L. Sr.		1963	618
Szaro	R.C.		1980	624
Taylor	D.L.		1973	632
Telfer	E.S.		1976	636
Thomas	J.W.	Maser, C.;Rodiek, J.E.	1978	647
Thomas	J.W.	Miller, R.J.;Maser, C.;Anderson, R.G.;Carter, B.E.	1979	650
Thomas	J.W.	Ruggiero, L.F.;Mannan, R.W.;Schoen, J.W.;Lancia, R.A.	1988	652
Thomas	J.W., tech		1979	643
Trial	H., Jr.		1986	660
Weaver	M.	Kellman, M.	1981	671
Weaver	M.	Kellman, M.	1981	672
Wein	R.W.	Riewe, K.R.;Methven, I.R., eds.	1982	675
Whitney	R.D.	McClain, K.M., eds.	1981	690
Willson	M.F.		1972	703
Winternitz	B.L.	Cahn, H.	1983	708
Zeedyk	W.D.	Evans, K.E.	1975	718

SUBSECTION INDEX
FOREST MANAGEMENT

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Ahlen	I.		1976	6
Anderson	R.J.		1985	15
Anonymous			0	1
Arbuckle	J.		1986	25
Back	G.N.		1982	30
Balda	R.P.	Gaud, W.S.;Brawn, J.D.	1983	34
Bamford	R.		1986	37
Barney	C.W.	Dils, R.E.	1972	38
Bart	J.		1979	39
Beebe	S.B.		1974	44
Bissonette	J.A., ed.		1986	55
Black	H. Jr.	Thomas, J.W.	1978	56
Bull	E.L.	Twombly, A.D.;Quigley, T.M.	1980	98
Bunnell	F.L.	Eastman, D.S.	1976	100
Bureau of Land Management			0	101
Capen	D.E.		1979	106
Capen	D.E.	Cooper, R.J.;DeGraaf, D.M.	1979	107
Cline	S.P.	Berg, A.B.;Wight, H.M.	1980	120
Cline	S.P.	Phillips, C.A.	1983	121
Conner	R.N.		1978	122
Conner	R.N.		1979	123
Conner	R.N.	Crawford, H.S.	1974	128
Conner	R.N.	Dickson, J.G.;Locke, B.A.	1981	129
Conner	R.N.	Hooper, R.G.;Crawford, H.S.;Mosby, H.S.	1975	132
Conner	R.N.	Locke, B.A.	1979	134
Coulmbe	R.	Lemay, A.B.	1982	141
Crawford	H.S.	Jennings, D.T.	1986	143
Currie	F.A.	Bamford, R.	1982	150
Curtis	R.L.	Ripley, T.H.	1975	151
Davis	J.W.	Goodwin, G.A.;Ockenfels, R.A., tech. coord.	1983	152
Dawson	D.K.		1979	155
DeGraaf	R.M.	Evans, K.E., eds.	1979	160
DeGraaf	R.M.	Shingo, A.L.	1985	162
DeGraaf	R.M., tech		1978	157
DeGraaf	R.M., tech		1980	159
Dickson	J.G.		1978	171
Dickson	J.G.	Conner, R.N.;Williamson, J.H.	1983	173
Dickson	J.G.	Segelquist, C.A.	1979	174
Diem	K.L.	Zeveloff, S.I.	1980	176
Edgerton	P.J.	Thomas, J.W.	1978	180
Edwards	M.G.		1978	181
Egeline	S.		1980	183
Endean	F.	Johnston, H.J.;Lees, J.L.	1971	188
Evans	K.E.		1978	197
Evans	K.E.		1978	198
Ffolliott	P.F.		1983	200
Field	R.	Williams, B.K.	1985	201
Fischer	W.C.	McClelland, B.R.	1983	204
Fox	R.	Rhea, B.	1989	211
Freedman	B.	Beauchamp, C.;McLaren, I.A.;Tingley, S.I.	1981	218
George	J.L	Mitchell, R.T.	1948	233
Gerell	R.		1988	234
Giles	R.H.		1962	237
Godell	B.S.	Kimball, A.;Hunter, M.L., Jr.	1986	243
Gould	W.P.		1962	245

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Graham	R.		1989	246
Gullion	G.W.		1977	250
Gullion	G.W.		1985	251
Gutierrez	R.J.	Carey, B. (tech. eds)	1985	255
Gutierrez	R.T.	Decker, D.J.;Howard, R.A., Jr.;Lassoie, J.P.	1979	254
Gysel	L.W.		1961	256
Hagar	D.C.		1960	258
Hale	J.B.	Gregg, L.E.	1976	261
Hamilton	R.B.	Noble, R.E.	1975	265
Hardin	K.I.	Evans, K.E.	1977	266
Harris	J.		1983	270
Harris	L.D.	Bowman, G.B.;McElveen, J.D.;Miller, R.I.;Trupe, S.	1978	271
Hassinger	J.D.	Liscinsky, S.A.;Shaw, S.P.	1975	273
Hicks	L.L.		1983	282
Hooper	R.G.		1978	288
Horton	S.P.	Mannan, R.W.	1988	293
Hungerford	K.E.		1969	297
Hunter	M.L. Jr.		1986	299
Jackson	J.A.		1977	303
Johnson	A.S.	Landers, J.L.	1982	313
Johnson	P.C.	Denton, R.E.	1975	316
Johnson	R.R.	McCormick, J.F., tech. coord.	1978	318
Kessler	W.B.	Kogut, T.E.	1985	338
Kilgore	B.M.		1971	340
Kimball	A.J.		1986	341
Lack	D.		1933	353
Lack	D.	Lack, E.	1951	355
Lanier	J.W.		1986	358
Lautenschlager	R.A.		1986	361
Lennartz	M.	Lancia, R.	1989	365
Lovejoy	T.E.	Bierregaard, R.O.;Rankin, J.M.;Schubart, H.O.R.	1983	370
MacDonald	J.E.		1966	386
Mannan	R.W.		1980	393
Mannan	R.W.		1982	394
Mannan	R.W.	Meslow, E.C.	1984	396
Marzluff	J.M.	Lyon, L.J.	1983	407
Maser	C.R.	Anderson, R.G.;Cromack, K. Jr.;Williams, J.T.;Martin, R.E.	1979	408
Mathisen	J.E.		1988	411
Maurer	B.A.	McArthur, L.B.;Whitmore, R.C.	1981	414
McCelland	B.R.		1980	419
McCelland	B.R.	Frissel, S.S.;Fischer, W.C.;Halvorson, C.H.	1979	421
McCelland	B.R.	Frissell, S.S.	1975	420
McClelland	B.R.		1977	418
McComb	W.C.	Rumsey, R.L.	1983	427
Mealy	S.P.	Horn, J.R.	1981	432
Menasco	K.A.		1983	436
Meslow	E.C.		1978	437
Meslow	E.C.	Maser, C.;Verner, J.	1981	438
Meslow	E.C.	Wight, H.M.	1975	439
Meyers	J.M.	Johnson, A.S.	1978	440
Miller	E.	Miller, D.R.	1980	442
Moriarty	J.J.	McComb, W.C.	1983	453
Morrison	M.L.		1982	455
Moss	D.		1978	467
Moss	D.		1978	466
Moss	D.	Taylor, P.N.;Easterbee, N.	1979	468
Myers	C.A.	Morris, M.J.	1975	471
Nagy	J.G.	Schwartz, C.C.		473
Newton	I.		1983	476

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Nilsson	S.G.		1979	481
Noble	R.E.	Hamilton, R.B.	1976	482
Oliveri	S.F.		1986	490
Perkins	C.J.		1974	502
Pinowski	B.C.		1976	510
Probst	J.R.		1979	512
Probst	J.R.		1988	513
Raphael	M.G		1980	517
Repenning	R.W.	Labisky, R.F.	1985	526
Reynolds	R.T.		1983	527
Reynolds	R.T.	Linkhart, B.D.;Jeanson, J.	1985	528
Roach	B.A.		1974	533
Robbins	C.S.		1979	535
Roe	N.A.		1974	539
Salwasser	H.	Tappeiner, J.C. II	1984	551
Sanderson	H.R.Bull,	Edgerton, P.J.	1980	554
Savidge	J.A.		1978	556
Schemnitz	S.D.		1973	557
Schemnitz	S.D.		1976	558
Schoen	J.W.	Wallmo, O.C.;Kirchhoff, M.D.	1981	559
Schultz	C.D.	Company Ltd.	1973	564
Scott	V.E.	Whelan, J.A.;Alexander, R.R.	1978	576
Scotter	K.A.		1980	579
Seymour	R.S.		1986	583
Shugart	H.H.	Smith, T.M.;Kitchings, J.T.;Kroodsma, R.L.	1978	592
Siderits	K.	Radtke, R.E.	1977	594
Silovsky	G.D.	Pinto, C.	1974	595
Slusher	J.P.	Hinkley, T.M., eds.	1974	598
Smith	D.R., tech		1975	600
Smith	K.G.		1980	602
Smith	T.M.	Shugart, H.H.;West, D.C.		603
Stelfox	J.G.		1984	615
Stubblefield	T.C.		1980	620
Styskel	E.W.		1983	621
Szaro	R.C.	Balda, R.P.	1979	625
Taber	R.D.	Manuwal, D.;West, S.D.;Raedeke, K.J.;deCalesta, D.	1981	628
Takekawa	J.Y.	Garton, E.O.;Lanelier, L.A.	1982	629
Taylor	C.M.	Taylor, W.E.	1979	630
Telfer	E.S.		1976	636
Telfer	E.S.		1977	639
Telfer	E.S.		1978	638
Telfer	E.S.		1981	640
Temple	S.A.	Maseman, M.J.;Ambuel, B.	1979	641
Thomas	J.W.	Anderson, R.G.;Maser, C.;Bull, E.L.	1979	644
Thomas	J.W.	Crouch, G.L.;Bumstead, R.S.;Bryant, L.D.	1975	645
Thomas	J.W.	Miller, R.;Maser, C.;Anderson, R.;Carter, B.	1978	651
Thomas	J.W.	Miller, R.J.;Black, H.;Rodick, J.E.;Maser, C.	1976	649
Thomas	J.W.	Miller, R.J.;Maser, C.;Anderson, R.G.;Carter, B.E.	1979	650
Thomas	J.W.	Ruggiero, L.F.;Mannan, R.W.;Schoen, J.W.;Lancia, R.A.	1988	652
Thomas	J.W., tech		1979	643
Titterington	R.W.	Crawford, H.S.;Burgason, B.N.	1979	656
Titus	R.		1983	657
Todd	C.S.	Owen, R.B., Jr.	1986	658
Trial	H., Jr.		1986	660
Welsh	D.A.		1988	679
Westworth	D.A.	Brusnyk, L.M.;Burns, G.R.	1984	682
Wetmore	S.P.	Booth, B.	1886	683
Wiens	J.A.		1975	692
Wight	H.M.		1974	693

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Williamson	K.		1970	700
Williamson	K.		1972	701
Wood	G.W.	Niles, L.J.	1978	709
Wood	G.W.	Niles, L.J.;Hendrick, R.M.;Davis, J.R.;Grimes, T.L.	1985	710
Yamasaki	M.	Tubbs, C.	1986	714
Zarnowitz	J.E.	Manuwal, D.A.	1985	717
Zeedyk	W.D.	Evans, K.E.	1975	718

SUBSECTION INDEX
TIMBER HARVEST

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Ahlen	I.		1976	6
Ambrose	R.E.		1975	27
Austin	D.D.	Perry, M.L.	1979	28
Back	G.N.		1979	29
Back	G.N.		1982	30
Barney	C.W.	Dils, R.E.	1972	38
Bell	M.A.M.	Brown, J.M.;Hubbard, W.F.	1974	47
Bendell	J.F.		1974	48
Bissonette	J.A., ed.		1986	55
Blake	J.G.		1982	58
Bryant	A.A.		1986	79
Bull	E.L.	Twombly, A.D.;Quigley, T.M.	1980	98
Bunnell	F.L.	Eastman, D.S.	1976	100
Burr	R.M.		1969	103
Capen	D.E.		1979	106
Cline	S.P.	Phillips, C.A.	1983	121
Conner	R.N.		1978	122
Conner	R.N.	Adkisson, C.S.	1974	125
Conner	R.N.	Adkisson, C.S.	1975	126
Conner	R.N.	Crawford, H.S.	1974	128
Conner	R.N.	Dickson, J.G.;Locke, B.A.;Segelquist, C.A.	1983	130
Conner	R.N.	Hooper, R.G.;Crawford, H.S.;Mosby, H.S.	1975	132
Conner	R.N.	Via, J.W.;Pather, I.D.	1979	138
Connor	R.N.	O'Halloran, K.A.	1987	137
Corns	I.G.W.	La Roi, G.H.	1976	139
Coulmbe	R.	Lemay, A.B.	1982	141
Crawford	H.S.	Hooper, R.G.;Titterington, R.W.	1981	142
Cross	C.W.		1963	147
Crouch	G.L.		1983	148
Curtis	R.L.	Ripley, T.H.	1975	151
Dawson	D.K.		1979	155
DeByle	N.V.		1981	156
DeGraaf	R.M.	Evans, K.E., eds.	1979	160
DeGraaf	R.M., tech		1978	157
DellaSala	D.A.		1986	165
Diamond	A.W.		1986	170
Dickson	J.G.	Conner, R.N.;Williamson, J.H.	1983	173
Dingledine	J.V.	Haufler, J.B.	1983	177
Edgerton	P.J.	Thomas, J.W.	1978	180
Endean	F.	Johnston, H.J.;Lees, J.L.	1971	188
Environment Council			1979	190
Ffolliott	P.F.		1983	200
Fischer	W.C.	McClelland, B.R.	1983	204
Franzreb	K.E.		1975	213
Franzreb	K.E.		1978	215
Franzreb	K.E.		1983	216
Franzreb	K.E.	Ohmart, R.D.	1978	217
Freedman	B.	Morgan, K.;Crowell, M.;Beauchamp, C.;Green, A.	1982	219
Frissell	S.		1984	221
Fry	K.		1982	222
Fuller	R.J.	Moreton, B.O.	1987	223
Glowacinski	Z.		1979	240
Graham	R.		1989	246
Gruell	G.E.	Schmidt, W.C.;Arno, S.F.;Reich, W.J.	1982	249
Gullion	G.W.		1985	251

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Gullion	G.W.		1986	252
Gysel	L.W.		1961	256
Haila	U.	Jarvinen, O.;Vaisanen, R.A.	1980	259
Hale	J.B.	Gregg, L.E.	1976	261
Hall	G.A.		1984	263
Hardin	K.I.	Evans, K.E.	1977	266
Harris	J.		1983	270
Harris	L.D.	Bowman, G.B.;McElveen, J.D.;Miller, R.I.;Trupe, S.	1978	271
Harris	L.D.	Maser, C.;McKee, A.	1982	272
Hassinger	J.D.	Liscinsky, S.A.;Shaw, S.P.	1975	273
Helle	P.		1985	277
Helle	P.		1987	278
Hicks	L.L.		1983	282
Hooper	R.G.		1978	288
Hooven	E.F.		1969	291
Hungerford	K.E.		1969	297
Johnson	A.S.	Landers, J.L.	1982	313
Kessler	W.B.		1979	336
Kessler	W.B.		1980	337
Kessler	W.B.	Kogut, T.E.	1985	338
Kimball	A.J.		1986	341
Lorenberg	E.I.		1964	367
Lovejoy	T.E.		1983	369
Lovejoy	T.E.	Bierregaard, R.O.;Rankin, J.M.;Schubart, H.O.R.	1983	370
Mannan	R.W.		1980	393
Manuwal	D.A.	Munger, G.	1978	398
Marcot	B.G.		1983	399
Marzluff	J.M.	Lyon, L.J.	1983	407
Maser	C.R.	Anderson, R.G.;Cromack, K. Jr.;Williams, J.T.;Martin, R.E.	1979	408
Mathisen	J.E.		1968	410
Maurer	B.A.	McArthur, L.B.;Whitmore, R.C.	1981	414
McCelland	B.R.		1980	419
McClelland	B.R.		1977	418
McComb	W.C.	Muller, R.N.	1983	425
McComb	W.C.	Noble, R.E.	1980	426
Medin	D.E.		1985	434
Medin	D.E.	Booth, G.D.	1989	435
Meslow	E.C.	Wight, H.M.	1975	439
Meyers	J.M.	Johnson, A.S.	1978	440
Micheal	E.D.	Thornburgh, P.I.	1971	441
Morgan	K.H.	Wetmore, S.P.;Smith, G.E.J.;Keller, R.A.	1989	452
Morrison	M.L.		1982	455
Morrison	M.L.	Meslow, E.C.	1983	456
Morrison	M.L.	Meslow, E.C.	1983	457
Morrison	M.L.	Meslow, E.C.	1984	460
Morrison	M.L.	Meslow, E.C.	1984	459
Myers	C.A.	Morris, M.J.	1975	471
Nagy	J.G.	Schwartz, C.C.		473
Niemi	G.J.	Hanowski, J.M.	1984	478
Noon	B.R.	Bingman, V.P.;Noon, J.P.	1979	485
Oliveri	S.F.		1986	490
Perkins	C.J.		1973	501
Perkins	C.J.		1974	502
Peterson	A.		1986	503
Peterson	E.B.	Peterson, N.M.	1983	505
Probst	J.R.		1979	512
Ramsden	D.J.	Lyon, L.J.;Halvorson, G.L.	1979	515
Raphael	M.G.		1983	518
Repenning	R.W.	Labisky, R.F.	1985	526

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Roach	B.A.		1974	533
Roe	N.A.		1974	539
Schemnitz	S.D.		1973	557
Schemnitz	S.D.		1976	558
Schoen	J.W.	Wallmo, O.C.;Kirchhoff, M.D.	1981	559
Schultz	C.D.	Company Ltd.	1973	564
Schwab	F.E.		1979	565
Scott	V.E.		1979	567
Scott	V.E.	Crouch, G.L.	1987	568
Scott	V.E.	Crouch, G.L.	1988	569
Scott	V.E.	Crouch, G.L.;Whelan, J.A.	1982	572
Scott	V.E.	Gottfried, G.J.	1983	574
Scoullar	K.A.		1980	579
Seymour	R.S.		1986	583
Silovsky	G.D.	Pinto, C.	1974	595
Slagsvold	T.		1977	596
Slusher	J.P.	Hinkley, T.M., eds.	1974	598
Small	M.F.	Johnson, W.N. Jr.	1986	599
Smith	D.R., tech		1975	600
Smith	K.G.		1980	602
Stelfox	J.G.		1984	615
Strelke	W.K.	Dickson, J.G.	1980	619
Stubblefield	T.C.		1980	620
Styskel	E.W.		1983	621
Szaro	R.C.	Balda, R.P.	1979	625
Szaro	R.C.	Balda, R.P.	1982	626
Szaro	R.C.	Balda, R.P.	1986	627
Taber	R.D.	Manuwal, D.;West, S.D.;Raedeke, K.J.;deCalesta, D.	1981	628
Telfer	E.S.		1974	635
Telfer	E.S.		1976	636
Telfer	E.S.		1977	637
Telfer	E.S.		1977	639
Thomas	J.W.	Crouch, G.L.;Bumstead, R.S.;Bryant, L.D.	1975	645
Thomas	J.W.	Miller, R.;Maser, C.;Anderson, R.;Carter, B.	1978	651
Thomas	J.W.	Miller, R.J.;Maser, C.;Anderson, R.G.;Carter, B.E.	1979	650
Thomas	J.W.	Ruggiero, L.F.;Mannan, R.W.;Schoen, J.W.;Lancia, R.A.	1988	652
Titterington	R.W.	Crawford, H.S.;Burgason, B.N.	1979	656
Titus	R.		1983	657
Todd	C.S.	Owen, R.B., Jr.	1986	658
Webb	W.L.		1977	673
Webb	W.L.	Behrend, D.F.;Sarworn, B.	1977	674
Welsh	D.A.		1981	676
Welsh	D.A.		1983	677
Welsh	D.A.	Fillman, D.R.	1980	680
Westworth	D.A.	Brusnyk, L.M.;Burns, G.R.	1984	682
Wetmore	S.P	Keller, R.A.;Smith, G.E.S.	1985	684
Wetmore	S.P.	Booth, B.	1886	683
Wiens	J.A.		1975	692
Wiens	J.A.		1978	691
Wight	H.M.		1974	693
Wilcove	D.S.		1987	696
Wood	G.W.	Niles, L.J.	1978	709
Yahner	R.H.		1986	711
Yahner	R.H.		1987	712
Yahner	R.H.	Scott, D.P.	1988	713
Zarnowitz	J.E.	Manuwal, D.A.	1985	717

SUBSECTION INDEX
FOREST FRAGMENTATION and AVIFAUNA

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Ambuel	B.	Temple, S.A.	1983	13
Anderson	S.H.	Robbins, C.S.	1981	21
Askins	R.A.	Philbrick, M.J.;Sugeno, D.S.	1987	27
Blake	J.G.		1983	60
Blake	J.G.		1983	59
Blake	J.G.	Karr, J.R.	1984	61
Blake	J.G.	Karr, J.R.	1987	62
Brittingham	M.C.	Temple, S.A.	1983	74
DellaSala	D.A.		1986	165
Forman	R.T.T.	Galli, A.E.;Leck, C.F.	1976	206
Fowler	N.E.	Howe, R.W.	1987	210
Freemark	K.E.	Merriam, H.G.	1986	220
Galli	A.E.	Leck, C.F.;Forman, R.T.T.	1976	228
Haila	U.	Jarvinen, O.;Vaisanen, R.A.	1980	259
Haila	Y.		1986	260
Harris	L.D.	Maser, C.;McKee, A.	1982	272
Howe	R.W.		1984	295
Kerlinger	P.	Doremus, C.	1981	335
Kimball	A.J.		1986	341
Lovejoy	T.E.	Bierregaard, R.O.;Rankin, J.M.;Schubart, H.O.R.	1983	370
Lovejoy	T.E.	Rankin, J.M.;Bierregaard, R.D.;Brown, K.S.;Emmons, L.H.; Van der Voot, M.E.	1984	371
Lynch	J.F.	Whigham, K.F.	1984	375
Lynch	J.F.	Whitcomb, R.F.	1978	376
MacClintock	L.	Whitcomb, R.F.;Whitcomb, B.L.	1977	385
McCoy	E.D.		1982	428
McLellan	C.H.	Dobson, A.P.;Wilcove, D.S.;Lynch, J.F.	1986	430
Morse	D.H.		1977	464
Robbins	C.S.		1979	535
Robbins	C.S.	Dawson, D.K.;Dowell, B.A.	1989	536
Samson	F.B.		1980	552
Shaffer	M.L.		1985	584
Szaro	R.C.		1980	624
Weaver	M.	Kellman, M.	1981	671
Whitcomb	B.L.	Whitcomb, R.F.;Bystrak, D.	1977	685
Whitcomb	R.F.		1977	686
Wilcove	D.S.		1985	695
Wilcove	D.S.		1987	696
Yahner	R.H.		1986	711
Yahner	R.H.		1987	712

SUBSECTION INDEX
FOREST FIRE and AVIFAUNA

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Ahlgren	I.F.	Ahlgren, C.E.	1960	7
Apfelbaum	S.	Haney, A.	1981	24
Back	G.N.		1979	29
Bendell	J.F.		1974	48
Bergstedt	B.	Niemi, G.J.	1974	49
Blackford	J.L.		1955	57
Blake	J.G.		1982	58
Bock	C.E.	Bock, J.H.	1983	65
Bock	C.E.	Lynch, J.F.	1970	66
Bock	C.E.	Raphael, M.;Bock, J.M.	1978	67
Bromley	R.G.		1973	75
Bunnell	F.L.	Eastman, D.S.	1976	100
Conner	R.N.	Locke, B.A.	1979	134
Crawford	H.S.	Hooper, R.G.;Titterington, R.W.	1981	142
Edwards	W.R.	Ellis, J.A.	1969	182
Emlen	J.T.		1970	185
Euler	D.L.	Thompson, D.Q.	1978	196
Fischer	W.C.	McClelland, B.R.	1983	204
Granholm	S.L.		1982	247
Hall	F.C.		1980	262
Hardin	K.I.	Evans, K.E.	1977	266
Harris	L.D.	Bowman, G.B.;McElveen, J.D.;Miller, R.I.;Trupe, S.	1978	271
Heinselman	M.L.		1973	276
Hooven	E.F.		1969	291
Johnson	A.S.	Landers, J.L.	1982	313
Kayll	A.J.		1968	327
Kelsall	J.P.	Telfer, E.S.;Wright, T.D.	1977	331
Kilgore	B.M.		1971	340
Komarek	E.V. Jr.		1969	344
Komarek	R.		1963	345
Lawrence	G.E.		1966	362
Lowe	P.O.	Ffolliott, P.F.;Dieterich, J.H.;Patton, D.	1978	373
Maser	C.R.	Anderson, R.G.;Cromack, K. Jr.;Williams, J.T.;Martin, R.E	1979	408
Meyers	J.M.	Johnson, A.S.	1978	440
Micheal	E.D.	Thornburgh, P.I.	1971	441
Morely	A.		1940	449
Myers	C.A.	Morris, M.J.	1975	471
Oliveri	S.F.		1986	490
Raphael	M.G		1980	517
Raphael	M.G.		1983	518
Roppe	J.A.	Hein, D.	1978	541
Rowe	J.S.	Scotter, G.W.	1973	546
Schemnitz	S.D.		1973	557
Schemnitz	S.D.		1976	558
Scotter	G.W.		1972	578
Smith	K.G.		1980	602
Spires	S.	Bendell, J.F.	1982	610
Stoddard	H.L. Sr.		1963	618
Styskel	E.W.		1983	621
Taber	R.D.	Manuwal, D.;West, S.D.;Raedeke, K.J.;deCalesta, D.	1981	628
Taylor	D.L.		1973	632
Taylor	D.L.		1979	633
Taylor	D.L.	Barmore, W.J. Jr.	1980	634
Theberge	J.B.		1976	642
Thomas	J.W.	Crouch, G.L.;Bumstead, R.S.;Bryant, L.D.	1975	645

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Thomas	J.W.	Miller, R.;Maser, C.;Anderson, R.;Carter, B.	1978	651
Thomas	J.W.	Miller, R.J.;Maser, C.;Anderson, R.G.;Carter, B.E.	1979	650
Wiens	J.A.		1975	692
Wiens	J.A.		1978	691
Zeedyk	W.D.	Evans, K.E.	1975	718

SUBSECTION INDEX
SILVICULTURAL PRACTICES and BIRDS

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Back	G.N.		1979	29
Bull	E.L.	Twombly, A.D.;Quigley, T.M.	1980	98
Bunnell	F.L.	Eastman, D.S.	1976	100
Burke	M.		1983	102
Capen	D.E.		1979	106
Cline	S.P.	Berg, A.B.;Wight, H.M.	1980	120
Cline	S.P.	Phillips, C.A.	1983	121
Conner	R.N.		1978	122
Conner	R.N.	Crawford, H.S.	1974	128
Coulmbe	R.	Lemay, A.B.	1982	141
Crawford	H.S.	Hooper, R.G.;Titterington, R.W.	1981	142
Crawforo	H.S.	Titterington, R.W.	1979	144
Curtis	R.L.	Ripley, T.H.	1975	151
Davis	J.W.	Goodwin, G.A.;Ockenfels, R.A., tech. coord.	1983	152
Dawson	D.K.		1979	155
DeGraaf	R.M.	Evans, K.E., eds.	1979	160
DeGraaf	R.M., tech		1978	157
Diem	K.L.	Zeveloff, S.I.	1980	176
Edgerton	P.J.	Thomas, J.W.	1978	180
Endean	F.	Johnston, H.J.;Lees, J.L.	1971	188
Environment Council			1979	190
Evans	K.E.		1978	197
Ffolliott	P.F.		1983	200
Freedman	B.	Beauchamp, C.;McLaren, I.A.;Tingley, S.I.	1981	218
Fry	K.		1982	222
Graham	R.		1989	246
Gysel	L.W.		1961	256
Hall	F.C.		1980	262
Hall	F.C.	Thomas, J.W.	1979	264
Hardin	K.I.	Evans, K.E.	1977	266
Harris	J.		1983	270
Hicks	L.L.		1983	282
Hooper	R.G.		1978	288
Hungerford	K.E.		1969	297
Johnson	A.S.	Landers, J.L.	1982	313
Kessler	W.B.		1979	336
Kimball	A.J.		1986	341
Lack	D.		1939	354
Lennartz	M.	Lancia, R.	1989	365
Lovejoy	T.E.		1983	369
MacWhorter	R.		1987	390
Mannan	R.W.		1980	393
Manuwal	D.A.	Munger, G.	1978	398
Mathisen	J.E.		1988	411
Meslow	E.C.		1978	437
Meslow	E.C.	Wight, H.M.	1975	439
Meyers	J.M.	Johnson, A.S.	1978	440
Moeur	M.		1989	445
Moriarty	J.J.	McComb, W.C.	1983	453
Morrison	M.L.	Meslow, E.C.	1983	456
Morrison	M.L.	Meslow, E.C.	1984	460
Morrison	M.L.	Meslow, E.C.	1984	459
Moss	D.	Taylor, P.N.;Easterbee, N.	1979	468
Myers	C.A.	Morris, M.J.	1975	471
Nilsson	S.G.		1979	481

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Oliveri	S.F.		1986	490
Perkins	C.J.		1973	501
Perkins	C.J.		1974	502
Probst	J.R.		1979	512
Repenning	R.W.	Labisky, R.F.	1985	526
Roach	B.A.		1974	533
Roe	N.A.		1974	539
Schemnitz	S.D.		1973	557
Schemnitz	S.D.		1976	558
Schoen	J.W.	Wallmo, O.C.;Kirchhoff, M.D.	1981	559
Scott	V.E.	Gottfried, G.J.	1983	574
Seymour	R.S.		1986	583
Silovsky	G.D.	Pinto, C.	1974	595
Slagsvold	T.		1977	596
Slusher	J.P.	Hinkley, T.M., eds.	1974	598
Smith	D.R., tech		1975	600
Smith	K.G.		1980	602
Stelfox	J.G.		1984	615
Stubblefield	T.C.		1980	620
Styskel	E.W.		1983	621
Szaro	R.C.	Balda, R.P.	1979	625
Szaro	R.C.	Balda, R.P.	1982	626
Taber	R.D.	Manuwal, D.;West, S.D.;Raedeke, K.J.;deCalesta, D.	1981	628
Telfer	E.S.		1976	636
Temple	S.A.	Maseman, M.J.;Ambuel, B.	1979	641
Thomas	J.W.	Crouch, G.L.;Bumstead, R.S.;Bryant, L.D.	1975	645
Thomas	J.W.	Miller, R.;Maser, C.;Anderson, R.;Carter, B.	1978	651
Thomas	J.W.	Miller, R.J.;Maser, C.;Anderson, R.G.;Carter, B.E.	1979	650
Titus	R.		1983	657
Welsh	D.A.		1983	677
Wight	H.M.		1974	693
Williamson	K.		1970	700
Wood	G.W.	Niles, L.J.	1978	709
Zarnowitz	J.E.	Manuwal, D.A.	1985	717
Zeedyk	W.D.	Evans, K.E.	1975	718

SUBSECTION INDEX
FOREST PROTECTION in RELATION to BIRDS

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Bart	J.		1979	39
Buckner	C.H.		1975	80
Buckner	C.H.	McLeod, B.B.	1975	90
Buckner	C.H.	McLeod, B.B.	1977	82
Buckner	C.H.	McLeod, B.B.;Gochnaver, T.A.	1974	83
Buckner	C.H.	McLeod, B.B.;Kingsbury, P.D.	1975	84
Buckner	C.H.	McLeod, B.B.;Kingsbury, P.D.	1975	86
Buckner	C.H.	McLeod, B.B.;Kingsbury, P.D.	1975	87
Buckner	C.H.	McLeod, B.B.;Kingsbury, P.D.	1975	85
Buckner	C.H.	McLeod, B.B.;Lidstone, R.G.	1976	88
Buckner	C.H.	McLeod, B.B.;Ray, D.G.H.	1973	89
Buckner	C.H.	Sarazin, R.	1975	90
Bunnell	F.L.	Eastman, D.S.	1976	100
Carrow	J.R.,Jr.		1974	114
Crawford	H.S.	Jennings, D.T.	1986	143
Curtis	R.L.	Ripley, T.H.	1975	151
Dawson	D.K.		1979	155
DeWeese	L.R.	Henny, C.J.;Floyd, R.L.;Bobal. K.A.;Schultz, A.W.	1979	168
Eidt	D.C.	Pearce, P.A.	1986	184
Evans	K.E.		1978	197
Finley	R.B.		1965	202
Fowle	C.D.		1965	208
Fowle	C.D.		1972	209
Grue	C.E.	Shipley, B.K.	1981	248
Hardin	K.I.	Evans, K.E.	1977	266
Harris	L.D.	Bowman, G.B.;McElveen, J.D.;Miller, R.I.;Trupe, S.	1978	271
Hudson	R.H.	Tucker, R.K.;Haegele, M.A.	1984	296
Hunter	M.L. Jr.		1981	298
Johnson	P.C.	Denton, R.E.	1975	316
Johnston	D.W.		1974	320
Johnston	D.W.		1975	321
Keith	J.O.	Hunt, E.	1969	330
Lautenschlag	R.A.		1986	361
Maser	C.R.	Anderson, R.G.;Cromack, K. Jr.;Williams, J.T.;Martin, R.E.	1979	408
McCluskey	D.C.	Thomas, J.W.;Meslow, E.C.	1977	422
McComb	W.C.	Rumsey, R.L.	1983	427
Morrison	M.L.		1982	455
Morrison	M.L.	Melow, E.C.	1983	458
Morrison	M.L.	Meslow, E.C.	1984	460
Morrison	M.L.	Meslow, E.C.	1984	459
Moulding	J.D.		1976	469
Myiberget	J.		1977	444
Oliveri	S.F.		1986	490
Pearce	P.A.	Garrity, N.R.	1981	497
Pearce	P.A.	Peakall, D.B.;Erskin, A.J.	1976	499
Pearce	P.A.	Peakall, D.B.;Erskine, A.J.	1979	498
Richmond	M.L.	Henny, C.J.;Floyd, R.L.;Mannan, R.W.;Finch, D.M.;DeWeese, L.	1979	531
Savidge	J.A.		1978	556
Schemnitz	S.D.		1973	557
Schemnitz	S.D.		1976	558
Slagsvold	T.		1977	596
Smith	G.J.		1987	601
Smith	K.G.		1980	602
Telfer	E.S.		1976	636
Thomas	J.W.	McCluskey, D.C.	1974	648

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Thomas	J.W.	Miller, R.;Maser, C.;Anderson, R.;Carter, B.	1978	651
Thomas	J.W.	Miller, R.J.;Maser, C.;Anderson, R.G.;Carter, B.E.	1979	650
Trial	H., Jr.		1986	660
Varty	J.W.		1978	664
Wiens	J.A.		1975	692
Wight	H.M.		1974	693

SUBSECTION INDEX
TECHNIQUES

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Anderson	S.H.		1980	18
Anderson	S.H.		1981	19
Arbuckle	J.		1986	25
Balda	R.P.	Gaud, W.S.;Brawn, J.D.	1983	34
Bamford	R.		1985	36
Beals	E.W.		1960	41
Boecklen	W.J.		1986	68
Bruns	H.		1960	76
Bull	E.L.	Henjum, M.G.;Anderson, R.G.	1987	93
Bull	E.L.	Partridge, A.D.	1986	95
Bull	E.L.	Partridge, A.D.;Williams, W.G.	1981	96
Bull	E.L.	Twombly, A.D.;Quigley, T.M.	1980	98
Bunnell	F.L.	Eastman, D.S.	1976	100
Capen	D.E.	Fenwick, J.W.;Inkley, D.B.;Boynton, A.C.	1986	108
Capen	D.E., ed.		1981	105
Carey	A.B.	Gill, J.D.	1983	111
Carey	A.B.	Sanderson, H.R.	1981	112
Cimon	N.		1983	117
Clark	K.	Euler, D.;Armstrong, E.	1983	118
Conner	R.N.	Adkisson, C.S.	1976	127
Conner	R.N.	Dickson, J.G.;Locke, B.A.	1981	129
Conner	R.N.	Dickson, J.G.;Locke, B.A.;Segelquist, C.A.	1983	130
Conner	R.N.	Dickson, J.G.;Williamson, J.H.	1983	131
Connor	R.N.	O'Halloran, K.A.	1987	137
Cottam	G.	Curtis, J.T.	1956	140
DeWeese	L.R.	Pillmore, R.E.;Richmond, M.L.	1975	169
Dickson	J.G.	Conner, R.N.;Fleet, R.R.;Kroll, J.C.;Jackson, J.A., eds.	1979	172
Emlen	J.T.		1971	186
Emlen	J.T., Jr.		1956	187
Finney	G.H.	Cadieux, P.;Silieff, E.	1980	203
Garrison	G.A.		1947	229
Gary	H.L.	Morris, M.J.	1980	230
Gates	J.E.	Mosher, J.A.	1981	231
Godell	B.S.	Kimball, A.;Hunter, M.L., Jr.	1986	243
Gotfryd	A.	Hansell, R.I.C.	1986	244
Hardin	K.I.	Evans, K.E.	1977	266
Hicks	L.L.		1983	282
James	F.C.		1971	306
James	F.C.		1978	307
James	F.C.	Shugart, H.H. Jr.	1970	309
Lancia	R.A.	Adams, D.A.	1985	356
MacArthur	R.H.	Horn, H.S.	1969	381
MacArthur	R.H.	MacArthur, J.W.;Preer, J.	1962	383
MacDonald	J.E.		1966	386
MacKenzie	J.M.D.		1952	388
Mannan	R.W.	Meslow, E.C.	1981	395
Marcot	B.G.	Raphael, M.G.;Gerry, K.H.	1983	401
Maurer	B.A.	McArthur, L.B.;Whitmore, R.C.	1981	413
Mawson	J.C.	Thomas, J.W.;DeGraaf, R.M.	1976	415
McComb	W.C.	Rumsey, R.L.	1983	427
McCoy	E.D.		1982	428
McLellan	C.H.	Dobson, A.P.;Wilcove, D.S.;Lynch, J.F.	1986	430
Mealy	S.P.	Horn, J.R.	1981	432
Moeur	M.		1989	445
Morgan	K.	Freedman, B.	1986	451

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORD NO
Morrison	M.L.	Raphael, M.G.;Heald, R.C.	1983	461
Morrison	M.L.	Timossi, I.C.;With, K.A.	1987	462
Nero	R.W.	Clark, R.J.;Knaptor, R.J.;Hamre, R.H. eds	1987	475
Nero	R.W.	Clark, R.J.;Knaptor, R.J.;Hamre, R.H. eds	1987	475
Nero	R.W.	Clark, R.J.;Knaptor, R.J.;Hamre, R.H. eds	1987	475
Nilsson	S.G.		1977	480
Noon	B.R.		1981	483
Peterson	A.		1986	503
Peterson	B.	Gauthier, G.	1985	504
Ralph	C.J.	Scott, J.M., eds.	1981	514
Ramsden	D.J.	Lyon, L.J.;Halvorson, G.L.	1979	515
Raphael	M.G.		1983	518
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Bull	E.L.	Partridge, A.D.	1986	95
Bull	E.L.	Partridge, A.D.;Williams, W.G.	1981	96
Bull	E.L.	Peterson, S.R.;Thomas, J.W.	1986	97
Bull	E.L.	Twombly, A.D.;Quigley, T.M.	1980	98
Bunnell	F.L.	Allaye-Chan, A.	1984	99
Bunnell	F.L.	Eastman, D.S.	1976	100
Bureau of L				101
Burke	M.		1983	102
Burr	R.M.		1969	103
Burr	R.M.	Jones, R.E.	1968	104
Capen	D.E., ed.		1981	105
Capen	D.E.		1979	106
Capen	D.E.	Cooper, R.J.;DeGraaf, D.M.	1979	107
Capen	D.E.	Fenwick, J.W.;Inkley, D.B.;Boynton, A.C.	1966	108
Carbyn	L.N.		1971	109
Carey	A.B.		1983	110
Carey	A.B.	Gill, J.D.	1983	111
Carey	A.B.	Sanderson, H.R.	1981	112
Carmichael	D.B. Jr.	Guynn, D.C., Jr.	1983	113
Carrow	J.R.,Jr.		1974	114
Casey	D.	Hein, D.	1983	115

AUTHOR	INITIAL	SECONDARY AUTHORS	YEAR	RECORDNO
Chasko	G.G.	Gates, J.E.	1982	116
Cimon	N.		1983	117
Clark	K.	Euler, D.;Armstrong, E.	1983	118
Cline	S.P.		1977	119
Cline	S.P.	Berg, A.B.;Wight, H.M.	1980	120
Cline	S.P.	Phillips, C.A.	1983	121
Conner	R.N.		1978	122
Conner	R.N.		1979	123
Conner	R.N.		1981	124
Conner	R.N.	Adkisson, C.S.	1974	125
Conner	R.N.	Adkisson, C.S.	1975	126
Conner	R.N.	Adkisson, C.S.	1976	127
Conner	R.N.	Crawford, H.S.	1974	128
Conner	R.N.	Dickson, J.G.;Locke, B.A.	1981	129
Conner	R.N.	Dickson, J.G.;Locke, B.A.;Segelquist, C.A.	1983	130
Conner	R.N.	Dickson, J.G.;Williamson, J.H.	1983	131
Conner	R.N.	Hooper, R.G.;Crawford, H.S.;Mosby, H.S.	1975	132
Conner	R.N.	Kroll, J.C.;Kulhavg, D.L.	1983	133
Conner	R.N.	Locke, B.A.	1979	134
Conner	R.N.	Locke, B.A.	1982	135
Conner	R.N.	Miller, O.K. Jr.;Adkisson, C.S.	1976	136
Connor	R.N.	O'Halloran, K.A.	1987	137
Conner	R.N.	Via, J.W.;Pather, I.D.	1979	138
Corns	I.G.W.	La Roi, G.H.	1976	139
Cottam	G.	Curtis, J.T.	1956	140
Coulmbe	R.	Lemay, A.B.	1982	141
Crawford	H.S.	Hooper, R.G.;Titterington, R.W.	1981	142
Crawford	H.S.	Jennings, D.T.	1986	143
Crawford	H.S.	Titterington, R.W.	1979	144
Crawford	H.S.	Titterington, R.W.;Jennings, D.T.	1983	145
Crockett	A.B.	Hanoley, P.L.	1978	146
Cross	C.W.		1963	147
Crouch	G.L.		1983	148
Cunningham	J.B.	Balda, R.P.;Gaud, W.S.	1980	149
Currie	F.A.	Bamford, R.	1982	150
Curtis	R.L.	Ripley, T.H.	1975	151
Davis	J.W.	Goodwin, G.A.;Ockenfels, R.A., tech. coord.	1983	152
Davis	P.R.		1976	153
Dawson	D.G.		1981	154
Dawson	D.K.		1979	155
DeByle	N.V.		1981	156
DeGraaf	R.M., tech		1978	157
DeGraaf	R.M.		1978	158
DeGraaf	R.M., tech		1980	159
DeGraaf	R.M.	Evans, K.E., eds.	1979	160
DeGraaf	R.M.	Chadwick, N.L.	1987	161
DeGraaf	R.M.	Shingo, A.L.	1985	162
DeGraaf	R.M	Wentworth, J.M.	70	163
DellaSala	D.A.		1986	165
DeLotelle	R.S.	Epting, R.J.	1988	166
Des Granges	J.L.		1980	167
DeWeese	L.R.	Henny, C.J.;Floyd, R.L.;Bobal. K.A.;Schultz, A.W.	1979	168
DeWeese	L.R.	Pillmore, R.E.;Richmond, M.L.	1975	169
Diamond	A.W.		1986	170
Dickson	J.G.		1978	171
Dickson	J.G.	Conner, R.N.;Fleet, R.R.;Kroll, J.C.;Jackson, J.A., eds.	1979	172
Dickson	J.G.	Conner, R.N.;Williamson, J.H.	1983	173
Dickson	J.G.	Segelquist, C.A.	1979	174
Dickson	J.G.	Segelquist, C.A.;Williamson, J.H.	1980	175

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Diem	K.L.	Zeveloff, S.I.	1980	176
Dingledine	J.V.	Haufler, J.B.	1983	177
Dowden	P.B.	Joynes, H.A.;Carolin, V.M.	1953	178
Dunlavy	J.C.		1935	179
Edgerton	P.J.	Thomas, J.W.	1978	180
Edwards	M.G.		1978	181
Edwards	W.R.	Ellis, J.A.	1969	182
Egeline	S.		1980	183
Eidt	D.C.	Pearce, P.A.	1986	184
Emlen	J.T.		1970	185
Emlen	J.T.		1971	186
Emlen	J.T., Jr.		1956	187
Endean	F.	Johnston, H.J.;Lees, J.L.	1971	188
Engstrom	K.		1955	189
Environment			1979	190
Erdelen	M.		1984	191
Erskine	A.J.		1968	192
Erskine	A.J.		1977	193
Erskine	A.J.		1978	194
Erksine	A.J.	McLaren, W.D.	1972	195
Euler	D.L.	Thompson, D.Q.	1978	196
Evans	K.E.		1978	197
Evans	K.E.		1978	198
Evans	K.E.	Conner, N.	1979	199
Ffolliott	P.F.		1983	200
Field	R.	Williams, B.K.	1985	201
Finley	R.B.		1965	202
Finney	G.H.	Cadieux, P.;Silieff, E.	1980	203
Fischer	W.C.	McClelland, B.R.	1983	204
Flack	J.A.D.		1976	205
Forman	R.T.T.	Galli, A.E.;Leck, C.F.	1976	206
Forsman	E.D.	Meslow, E.C.;Strab, M.J.	1977	207
Fowle	C.D.		1965	208
Fowle	C.D.		1972	209
Fowler	N.E.	Howe, R.W.	1987	210
Fox	R.	Rhea, B.	1989	211
Francis	J.	Lumbis, K.	1979	212
Franzreb	K.E.		1975	213
Franzreb	K.E.		1977	214
Franzreb	K.E.		1978	215
Franzreb	K.E.		1983	216
Franzreb	K.E.	Ohmart, R.D.	1978	217
Freedman	B.	Beauchamp, C.;McLaren, I.A.;Tingley, S.I.	1981	218
Freedman	B.	Morgan, K.;Crowell, M.;Beauchamp, C.;Green, A.	1982	219
Freemark	K.E.	Merriam, H.G.	1986	220
Frissell	S.		1984	221
Fry	K.		1982	222
Fuller	R.J.	Moreton, B.O.	1987	223
Gage	S.H.	Miller, C.A.	1978	224
Gale	R.M.		1973	225
Gale	R.M.		1973	226
Galli	A.E.		1974	227
Galli	A.E.	Leck, C.F.;Forman, R.T.T.	1976	228
Garrison	G.A.		1947	229
Gary	H.L.	Morris, M.J.	1980	230
Gates	J.E.	Mosher, J.A.	1981	231
Gauthreaux	S.A. Jr.		1978	232
George	J.L	Mitchell, R.T.	1948	233
Gerell	R.		1988	234

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Germain	P.	Morin, G.	1979	235
Germain	P.	Tingley, S.	1980	236
Giles	R.H.		1962	237
Gill	J.D.	DeGraaf, R.M.;Thomas, J.W.	1974	238
Glowacinski	Z.		1975	239
Glowacinski	Z.		1979	240
Glowacinski	Z.	Jarvinen, O.	1975	241
Glowacinski	Z.	Weiner, J.	1983	242
Godell	B.S.	Kimball, A.;Hunter, M.L., Jr.	1986	243
Gotfryd	A.	Hansell, R.I.C.	1986	244
Gould	W.P.		1962	245
Graham	R.		1989	246
Granholm	S.L.		1982	247
Grue	C.E.	Shipley, B.K.	1981	248
Gruell	G.E.	Schmidt, W.C.;Arno, S.F.;Reich, W.J.	1982	249
Gullion	G.W.		1977	250
Gullion	G.W.		1985	251
Gullion	G.W.		1986	252
Gutierrez	R.J.		1985	253
Gutierrez	R.T.	Decker, D.J.;Howard, R.A., Jr.;Lassoie, J.P.	1979	254
Gutierres	R.J.	Carey, B. (tech. eds)	1985	255
Gysel	L.W.		1961	256
Haapanen	A.		1965	257
Hagar	D.C.		1960	258
Haila	U.	Jarvinen, O.;Vaisanen, R.A.	1980	259
Haila	Y.		1986	260
Hale	J.B.	Gregg, L.E.	1976	261
Hall	F.C.		1980	262
Hall	G.A.		1984	263
Hall	F.C.	Thomas, J.W.	1979	264
Hamilton	R.B.	Noble, R.E.	1975	265
Hardin	K.I.	Evans, K.E.	1977	266
Harestad	A.S.	Keisker, D.G.	1989	267
Hager	R.		1978	268
Harlow	R.F.	Gaynn, D.C., Jr.	1983	269
Harris	J.		1983	270
Harris	L.D.	Bowman, G.B.;McElveen, J.D.;Miller, R.I.;Trupe, S.	1978	271
Harris	L.D.	Maser, C.;McKee, A.	1982	272
Hassinger	J.D.	Liscinsky, S.A.;Shaw, S.P.	1975	273
Haws	K.		1987	274
Heard	J.L.		1979	275
Heinselman	M.L.		1973	276
Helle	P.		1985	277
Helle	P.		1987	278
Helle	P.	Fuller, R.J.	1988	279
Herrera	C.M.		1978	280
Herrera	C.M.		1978	281
Hicks	L.L.		1983	282
Lautenschla	R.A.		1986	283
Holling	C.S.		1988	284
Holmes	R.T.	Robinson, S.K.	1981	285
Holt	D.W.	Hillis, J.M.	1987	286
Hooper	R.G.		1967	287
Hooper	R.G.		1978	288
Hooper	R.G.	Crawford, H.S.	1969	289
Hooper	R.G.	Crawford, H.S.;Harlow, R.F.	1973	290
Hooven	E.F.		1969	291
Hopkins	R.B.	Cassel, J.F.;Bjugstad, A.J.	1986	292
Horton	S.P.	Mannan, R.W.	1988	293

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Horvath	O.,		1963	294
Howe	R.W.		1984	295
Hudson	R.H.	Tucker, R.K.;Haegele, M.A.	1984	296
Hungerford	K.E.		1969	297
Hunter	M.L. Jr.		1981	298
Hunter	M.L. Jr.		1986	299
Hutchison	F.T.		1951	300
Jacknian	S.M.		1974	301
Jackson	J.A.		1970	302
Jackson	J.A.		1977	303
Jackson	J.A.	Jackson, D.J.J.	1986	304
Jackson	J.A.	Lennartz, M.K.;Hooper, R.G.	1979	305
James	F.C.		1971	306
James	F.C.		1978	307
James	F.C.	Rathbun, S.	1981	308
James	F.C.	Shugart, H.H. Jr.	1970	309
James	F.C.	Wamer, N.O.	1982	310
Janik	C.A.		1980	311
Jardine	D.C. ed.		1988	312
Johnson	A.S.	Landers, J.L.	1982	313
Johnson	H.J.	Cerezke, H.F.;Endean, F.;Hillman, G.R.;Kiil, A.D.;Lees, J.C. Loman,A.A.;Powell,J.A.	1971	314
Johnson	N.K.		1975	315
Johnson	P.C.	Denton, R.E.	1975	316
Johnson	R.R.	Jones, D.A., eds.	1977	317
Johnson	R.R.	McCormick, J.F., tech. coord.	1978	318
Johnston	D.W.		1970	319
Johnston	D.W.		1974	320
Johnston	D.W.		1975	321
Johnston	D.W.	Odum, E.P.	1956	322
Jones	P.H.		1972	323
Karr	J.R.		1968	324
Karr	J.R.		1976	325
Karr	J.R.	Roth, R.R.	1971	326
Kayll	A.J.		1968	327
Keast	A.	Morton, E.S.	1980	328
Keisker	D.G.		1987	329
Keith	J.O.	Hunt, E.	1969	330
Kelsall	J.P.	Telfer, E.S.;Wright, T.D.	1977	331
Kendeigh	S.C.		1946	332
Kendeigh	S.C.		1947	333
Kendeigh	S.C.		1948	334
Kerlinger	P.	Doremus, C.	1981	335
Kessler	W.B.		1979	336
Kessler	W.B.		1980	337
Kessler	W.B.	Kogut, T.E.	1985	338
Kilgore	B.M.		1968	339
Kilgore	B.M.		1971	340
Kimball	A.J.		1986	341
Kitts	J.R.		1981	342
Knight	F.R.		1958	343
Komarek	E.V. Jr.		1969	344
Komarek	R.		1963	345
Koonz	W.H.		1988	346
Koplin	J.R.		1967	347
Koplin	J.R.		1969	348
Koplin	J.R.		1972	349
Koplin	J.R.	Baldwin, P.H.	1970	350
Kricher	J.C.	William, E.D., Jr.	1986	351

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Kroodsma	R.L.		1982	352
Lack	D.		1933	353
Lack	D.		1939	354
Lack	D.	Lack, E.	1951	355
Lancia	R.A.	Adams, D.A.	1985	356
Landers	P.B.	MacMahon, J.A.	1980	357
Lanier	J.W.		1986	358
Larsen	J.A.		1980	359
Hilden	O		1965	360
Lawrence	G.E.		1966	362
Lay	D.W.		1938	363
Lennartz	M.R.	Bjugstad, A.J.	1975	364
Lennartz	M.	Lancia, R.	1989	365
Levenson	J.B.		1981	366
Larenburg	E.I.		1964	367
Lovejoy	T.E.		1972	368
Lovejoy	T.E.		1983	369
Lovejoy	T.E.	Bierregaard, R.O.;Rankin, J.M.;Schubart, H.O.R.	1983	370
Lovejoy	T.E.	Rankin, J.M.;Bierregaard, R.O.;Brown, K.S.;Emmons, L.H.; Van der Voot	1984	371
Lowe	P.O.		1975	372
Lowe	P.O.	Ffolliott, P.F.;Dietrich, J.H.;Patton, D.	1978	373
Luman	I.D.	Neitro, W.A.	1980	374
Lynch	J.F.	Whigham, K.F.	1984	375
Lynch	J.F.	Whitcomb, R.F.	1978	376
Lyon	L.J.	Crawford, J.S.;Czvhai, E.;Fredriksen, R.L.;Harlow, R.F.;Metz,L.J. Pearson, H.A.	1978	377
MacArthur	R.H.		1958	378
MacArthur	R.H.		1959	379
MacArthur	R.H.		1964	380
MacArthur	R.H.	Horn, H.S.	1969	381
MacArthur	R.H.	MacArthur, J. W.	1961	382
MacArthur	R.H.	MacArthur, J.W.;Preer, J.	1962	383
MacArthur	R.H.	Recher, H.;Cody, M.	1966	384
MacClintock	L.	Whitcomb, R.F.;Whitcomb, B.L.	1977	385
MacDonald	J.E.		1966	386
MacKenzie	D.I.	Sealy, S.G.;Sutherland, G.D.	1982	387
MacKenzie	J.M.D.		1952	388
MacLellan	C.R.		1959	389
MacWhorter	R.		1987	390
Maithani	G.P., ed.		1986	391
Mannan	R.W.		1977	392
Mannan	R.W.		1980	393
Mannan	R.W.		1982	394
Mannan	R.W.	Meslow, E.C.	1981	395
Mannan	R.W.	Meslow, E.C.	1984	396
Mannan	R.W.	Meslow, E.C.;Wight, H.M.	1980	397
Manuwal	D.A.	Munger, G.	1978	398
Marcot	B.G.		1983	399
Marcot	B.G.		1984	400
Marcot	B.G.	Raphael, M.G.;Gerry, K.H.	1983	401
Marshall	P.B.		1971	402
Martin	N.D.		1960	403
Martin	T.E.		1980	404
Martin	T.E.		1988	405
Martin	T.E.	Karr, J.R.	1986	406
Marzluff	J.M.	Lyon, L.J.	1983	407
Maser	C.R.	Anderson, R.G.;Cromack, K. Jr.;Williams, J.T.;Martin, R.E.	1979	408
Massey	C.L.	Wygant, N.D.	1973	409

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Mathisen	J.E.		1968	410
Mathisen	J.E.		1988	411
Mathisen	J.E.	Sorenson, D.J.;Frenzel, L.D.;Dunstan, T.C.	1977	412
Maurer	B.A.	McArthur, L.B.;Whitmore, R.C.	1981	413
Maurer	B.A.	McArthur, L.B.;Whitmore, R.C.	1981	414
Mawson	J.C.	Thomas, J.W.;DeGraaf, R.M.	1976	415
McArthur	L.B.	Whitmore, R.C.	1979	416
McCambridge	W.F.	Knight, F.B.	1972	417
McClelland	B.R.		1977	418
McCelland	B.R.		1980	419
McCelland	B.R.	Frissell, S.S.	1975	420
McCelland	B.R.	Frissel, S.S.;Fischer, W.C.;Halvorson, C.H.	1979	421
McCluskey	D.C.	Thomas, J.W.;Meslow, E.C.	1977	422
McComb	W.C.		1979	423
McComb	W.C.	Bonney. S.A.;Sheffield, R.M.;Cost, N.D.	1986	424
McComb	W.C.	Muller, [illegible].N.	1983	425
McComb	W.C.	Noble, R.E.	1980	426
McComb	W.C.	Rumsey, R.L.	1983	427
McCoy	E.D.		1982	428
McGarigal	K.	Faser, J.D.	1984	429
McLellan	C.H.	Dobson, A.P.;Wilcove, D.S.;Lynch, J.F.	1986	430
McNeil	R.		1982	431
Mealy	S.P.		1981	432
Medin	D.E.		1985	433
Medin	D.E.		1985	434
Medin	D.E.	Booth, G.D.	1989	435
Menasco	K.A.		1983	436
Meslow	E.C.		1978	437
Meslow	E.C.	Maser, C.;Verner, J.	1981	438
Meslow	E.C.	Wight, H.M.	1975	439
Meyers	J.M.	Johnson, A.S.	1978	440
Micheal	E.D.	Thornburgh, P.I.	1971	441
Miller	E.	Miller, D.R.	1980	442
Miller	E.	Partridge, A.D.;Bull, E.C.	1979	443
Myiberget	J.		1977	444
Moeur	M.		1989	445
Monkkonen	M.	Helle, P.	1987	446
Monson	G.		1941	447
Moore	N.W.	Hooper, M.D.	1975	448
Morely	A.		1940	449
Morgan	K.H.		1984	450
Morgan	K.	Freedman, B.	1986	451
Morgan	K.H.	Wetmore, S.P.;Smith, G.E.J.;Keller, R.A.	1989	452
Moriarty	J.J.	McComb, W.C.	1983	453
Morrison	M.L.		1981	454
Morrison	M.L.		1982	455
Morrison	M.L.	Meslow, E.C.	1983	456
Morrison	M.L.	Meslow, E.C.	1983	457
Morrison	M.L.	Melow, E.C.	1983	458
Morrison	M.L.	Meslow, E.C.	1984	459
Morrison	M.L.	Meslow, E.C.	1984	460
Morrison	M.L.	Raphael, M.G.;Heald, R.C.	1983	461
Morrison	M.L.	Timossi, I.C.;With, K.A.	1987	462
Morrison	M.L.	With, K.A.;Timossi, I.C.	1986	463
Morse	D.H.		1977	464
Morton	E.S.		1980	465
Moss	D.		1978	466
Moss	D.		1978	467
Moss	D.	Taylor, P.N.;Easterbee, N.	1979	468

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Moulding	J.D.		1976	469
Munger	G.P.		1974	470
Myers	C.A.	Morris, M.J.	1975	471
Myiberget	S., ed.		1985	472
Nagy	J.G.	Schwartz, C.C.		473
Nelson	S.G.		1975	474
Nero	R.W.	Clark, R.J.;Kraptor, R.J.;Hamre, R.H. eds	1987	475
Newton	I.		1983	476
Niemi	J.		1976	477
Niemi	G.J.	Hanowski, J.M.	1984	478
Niemi	G.J.	Pfannmuller, L.	1979	479
Nilsson	S.G.		1977	480
Kilsson	S.G.		1979	481
Noble	R.E.	Hamilton, R.B.	1976	482
Noon	B.R.		1981	483
Noon	B.R.	Able, K.P.	1978	484
Noon	B.R.	Bingman, V.P.;Noon, J.P.	1979	485
Nowakowski	N.A.		1980	486
O'Meura	T.E.	Haufler, J.B.;Stelter, L.H.;Nagy, J.G.	1981	487
Odum	E.P.		1950	488
Oelke	H.		1967	489
Oliveri	S.F.		1986	490
Opdam	P.	Schotman, A.	1986	491
Osaki	S.K.		1979	492
Otvos	I.S.		1979	493
Patril	G.P.	Taillie, C.	1979	494
Patrice	R		1987	495
Pearce	P.A.	Brun, G.L.;Witteman, J.	1979	496
Pearce	P.A.	Garrity, N.R.	1981	497
Pearce	P.A.	Peakall, D.B.;Erskine, A.J.	1979	498
Pearce	P.A.	Peakall, D.B.;Erskin, A.J.	1976	499
Pearson	D.L.		1975	500
Perkins	C.J.		1973	501
Perkins	C.J.		1974	502
Peterson	A.		1986	503
Peterson	B.	Gauthier, G.	1985	504
Peterson	E.B.	Peterson, N.M.	1983	505
Peterson	S.R.		1975	506
Petit	D.R.	Petit, K.E.;Grubb, T.C., Jr.	1985	507
Petty	S.J.		1988	508
Pimentel	D.		1971	509
Pinowski	B.C.		1976	510
Plunkett	R.L.		1979	511
Probst	J.R.		1979	512
Probst	J.R.		1988	513
Ralph	C.J.	Scott, J.M., eds.	1981	514
Ramsden	D.J.	Lyon, L.J.;Halvorson, G.L.	1979	515
Ranney	J.W.	Bruner, M.C.;Levenson, J.B.	1981	516
Raphael	M.G		1980	517
Raphael	M.G.		1983	518
Raphael	M.G.		1984	519
Raphael	M.G.	White, M.	1978	520
Raphael	M.G.	White, M.	1984	521
Rappole	J.H.	Morton, E.S.	1985	522
Rappole	J.H.	Morton, E.S.;Lovejoy, T.E.;Rous, J.L.	1983	523
Rasmussen	W.O.	Ffolliott, P.F.	1983	524
Recher	H.		1969	525
Repenning	R.W.	Labisky, R.F.	1985	526
Reynolds	R.T.		1983	527

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Reynolds	R.T.	Linkhart, B.D.;Jeanson, J.	1985	528
Reynolds	R.T.	Scott, J.M.;Nussbaum, R.A.	1980	529
Rice	J.	Anderson, B.W.;Ohmart, R.D.	1984	530
Richmond	M.L.	Henny, C.J.;Floyd, R.L.;Mannan, R.W.;Finch, D.M.;DeWeese, L.R.	1979	531
Richter	J.		1980	532
Roach	B.A.		1974	533
Robbins	C.S.		1978	534
Robbins	C.S.		1979	535
Robbins	C.S.	Dawson, D.K.;Dowell, B.A.	1989	536
Robbins	C.S.	Erskine, A.J.	1975	537
Roble	R.J.	Browning, N.G.	1981	538
Roe	N.A.		1974	539
Roppe	J.A.		1973	540
Roppe	J.A.	Hein, D.	1978	541
Rosenburg	D.K.	Fraser, J.D.;Stauffer, D.F.	1988	542
Rotenberry	J.T.	Wiens, J.A.	1981	543
Roth	R.R.		1976	544
Rov	N.		1975	545
Rowe	J.S.	Scotter, G.W.	1973	546
Runde	D.E.		1981	547
Runde	D.E.	Capen, D.E.	1987	548
Ruppert	K.		1953	549
Salt	G.W.		1957	550
Salwasser	H.	Tappeiner, J.C. II	1984	551
Samson	F.B.		1980	552
Sanders	C.J.		1970	553
Sanderson	H.R.Bull,	Edgerton, P.J.	1980	554
Savidge	J.A.		1977	555
Savidge	J.A.		1978	556
Schemnitz	S.D.		1973	557
Schemnitz	S.D.		1976	558
Schoen	J.W.	Wallmo, O.C.;Kirchhoff, M.D.	1981	559
Schroeder	R.L.		1982	560
Schroeder	R.L.		1983	561
Schroeder	R.L.		1983	562
Schroeder	R.L.		1982	563
Schultz	C.D.	Company Ltd.	1973	564
Schwab	F.E.		1979	565
Scott	V.E.		1978	566
Scott	V.E.		1979	567
Scott	V.E.	Crouch, G.L.	1987	568
Scott	V.E.	Crouch, G.L.	1988	569
Scott	V.E.	Crouch, G.L.	1988	570
Scott	V.E.	Crouch, G.L.	1988	571
Scott	V.E.	Crouch, G.L.;Whelan, J.A.	1982	572
Scott	V.E.	Evans, K.E.;Patton, D.R.;Stone, C.P.	1977	573
Scott	V.E.	Gottfried, G.J.	1983	574
Scott	V.E.	Oldemeyer, J.L.	1983	575
Scott	V.E.	Whelan, J.A.;Alexander, R.R.	1978	576
Scott	V.E.	Whelan, J.A.;Svoboda, P.L.	1980	577
Scotter	G.W.		1972	578
Scotter	K.A.		1980	579
Sedgewick	J.A.	Knopf, F.L.	1986	580
Serrao	J.		1985	581
Servos	M.C.		1987	582
Seymour	R.S.		1986	583
Shaffer	M.L.		1985	584
Sheffield	R.M.		1981	585
Shilova-Kra	S.A.		1953	586

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Shook	R.S.	Baldwin, P.H.	1970	587
Shugart	H.H.	Crow, T.R.;Hett, J.M.	1973	588
Shugart	H.H.	Anderson, S.H.;Strand, R.H.	1975	589
Shugart	H.H.	Dueser, R.D.;Anderson, S.H.	1974	590
Shugart	H.H.	James, D.	1973	591
Shugart	H.H.	Smith, T.M.;Kitchings, J.T.;Kroodsma, R.L.	1978	592
Shugart	H.H.	West, D.C.	1980	593
Siderits	K.	Radtke, R.E.	1977	594
Silovsky	G.D.	Pinto, C.	1974	595
Slagsvold	T.		1977	596
Sloan	N.F.	Coppel, H.C.	1968	597
Slusher	J.P.	Hinkley, T.M., eds.	1974	598
Small	M.F.	Johnson, W.N. Jr.	1986	599
Smith	D.R., tech		1975	600
Smith	G.J.		1987	601
Smith	K.G.		1980	602
Smith	T.M.	Shugart, H.H.;West, D.C.		603
Smith	T.M.	Shugart, H.H.;West, D.C.	1981	604
Snyder	D.P.		1950	605
Sousa	P.J.		1982	606
Sousa	P.J.		1983	607
Sousa	P.J.		1983	608
Sousa	P.J.		1987	609
Spires	S.	Bendell, J.F.	1982	610
Sprunt	A. IV		1975	611
Stanton	F.		1975	612
Stauffer	D.F.	Best, L.B.	1980	613
Stauffer	D.F.	Best, L.B.	1982	614
Stelfox	J.G.		1984	615
Stevens	L.E.	Brown, B.T.;Simpson, J.M.;Johnson, R.R.	1977	616
Stewart	R.E.	Aldrich, J.W.	1949	617
Stoddard	H.L. Sr.		1963	618
Strelke	W.K.	Dickson, J.G.	1980	619
Stubblefiel	T.C.		1980	620
Styskel	E.W.		1983	621
Swallow	S.K.		1986	622
Swift	B.L.	Larson, J.S.;DeGraff, R.M.	1984	623
Szaro	R.C.		1980	624
Szaro	R.C.	Balda, R.P.	1979	625
Szaro	R.C.	Balda, R.P.	1982	626
Szaro	R.C.	Balda, R.P.	1986	627
Taber	R.D.	Manuwal, D.;West, S.D.;Raedeke, K.J.;deCalesta, D.	1981	628
Takekawa	J.Y.	Garton, E.O.;Lanelier, L.A.	1982	629
Taylor	C.M.	Taylor, W.E.	1979	630
Taylor	D.L.		1969	631
Taylor	D.L.		1973	632
Taylor	D.L.		1979	633
Taylor	D.L.	Barmore, W.J. Jr.	1980	634
Telfer	E.S.		1974	635
Telfer	E.S.		1976	636
Telfer	E.S.		1977	637
Telfer	E.S.		1978	638
Telfer	E.S.		1977	639
Telfer	E.S.		1981	640
Temple	S.A.	Maseman, M.J.;Ambuel, B.	1979	641
Theberge	J.B.		1976	642
Thomas	J.W., tech		1979	643
Thomas	J.W.	Anderson, R.G.;Maser, C.;Bull, E.L.	1979	644
Thomas	J.W.	Crouch, G.L.;Bumstead, R.S.;Bryant, L.D.	1975	645

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Thomas	J.W.	DeGraaf, R.M.;Mawson, J.C.	1977	646
Thomas	J.W.	Maser, C.;Rodiek, J.E.	1978	647
Thomas	J.W.	McCluskey, D.C.	1974	648
Thomas	J.W.	Miller, R.J.;Black, H.;Rodick, J.E.;Maser, C.	1976	649
Thomas	J.W.	Miller, R.J.;Maser, C.;Anderson, R.G.;Carter, B.E.	1979	650
Thomas	J.W.	Miller, R.;Maser, C.;Anderson, R.;Carter, B.	1978	651
Thomas	J.W.	Ruggiero, L.F.;Mannan, R.W.;Schoen, J.W.;Lancia, R.A.	1988	652
Tilghman	N.G.		1985	653
Tilghman	N.G.		1987	654
Timber Mana			1989	655
Titterinton	R.W.	Crawford, H.S.;Burgason, B.N.	1979	656
Titus	R.		1983	657
Todd	C.S.	Owen, R.B., Jr.	1986	658
Tramer	E.J.		1969	659
Trial	H., Jr.		1986	660
Tubbs	A.A.		1980	661
USDA Forest			1973	662
Van Horne	B.		1983	663
Varty	J.W.		1978	664
Venables	L.S.V.	Venables, U.M.	1969	665
Verner	J.		1981	666
Verner	J.		1975	667
Verner	J.		1980	668
Wagner	J.L.		1981	669
Waide	R.B.		1980	670
Weaver	M.	Kellman, M.	1981	671
Weaver	M.	Kellman, M.	1981	672
Webb	W.L.		1977	673
Webb	W.L.	Behrend, D.F.;Sarworn, B.	1977	674
Wein	R.W.	Riewe, K.R.;Methven, I.R., eds.	1982	675
Welsh	D.A.		1981	676
Welsh	D.A.		1983	677
Welsh	D.A.		1987	678
Welsh	D.A.		1988	679
Welsh	D.A.	Fillman, D.R.	1980	680
West	G.C.	DeWolfe, B.B.	1974	681
Westworth	D.A.	Brusnyk, L.M.;Burns, G.R.	1984	682
Wetmore	S.P.	Booth, B.	1886	683
Wetmore	S.P.	Keller, R.A.;Smith, G.E.S.	1985	684
Whitcomb	B.L.	Whitcomb, R.F.;Bystrak, D.	1977	685
Whitcomb	R.F.		1977	686
Whitcomb	R.F.	Robbins, C.S.;Lynch, J.F.;Whitcomb, B.L.;Klimkietwicz, M.K.; Bystrak,D.	1981	687
White	R.P.		1987	688
Whitfield	D.W.A.	Gerrard, J.M.;Maher, W.J.;Davis, D.W.	1974	689
Whitney	R.D.	McClain, K.M., eds.	1981	690
Wiens	J.A.		1978	691
Wiens	J.A.		1975	692
Wight	H.M.		1974	693
Wilcove	D.S.		1985	694
Wilcove	D.S.		1985	695
Wilcove	D.S.		1987	696
Wilcove	D.S.	Terborgh, J.W.	1984	697
Williams	J.B.		1975	698
Williamson	K		1972	699
Williamson	K.		1970	700
Williamson	K.		1972	701
Willner	G.R.	Gates, J.E.;Devlin, W.J.	1983	702
Willson	M.F.		1972	703

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Willson	M.F.		1976	704
Winkler	D.W.	Dana, G.	1977	705
Winternitz	B.L.		1976	706
Winternitz	B.L.		1980	707
Winternitz	B.L.	Cahn, H.	1983	708
Wood	G.W.	Niles, L.J.	1978	709
Wood	G.W.	Niles, L.J.;Hendrick, R.M.;Davis, J.R.;Grimes, T.L.	1985	710
Yahner	R.H.		1986	711
Yahner	R.H.		1987	712
Yahner	R.H.	Scott, D.P.	1988	713
Yamasaki	M.	Tubbs, C.	1986	714
Yeager	L.E.		1955	715
Zarnowtiz	J.E.		1982	716
Zarnowitz	J.E.	Manuwal, D.A.	1985	717
Zeedyk	W.D.	Evans, K.E.	1975	718